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USSR Report

SCIENCE AND TECHNOLOGY POLICY

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ORGANIZATION, PLANNING AND COORDINATION

USSR ACADEMY OF SCIENCES PRESIDENT ON SAFE PROGRESS

Moscow NTR: PROBLEMY I RESHENIY in Russian No 19, 7-20 Oct 86 pp 4-5

[Interview with Boris Yevgenevich Paton, president of the USSR Academy of Sciences, by F. Vladov, date and place not given]

> [Text] Any growth in mankind's industrial capacity must be preceded by an increase in responsibility for its development. In an appearance on Soviet television M.S. Gorbachev emphasized that "... the issues of system reliability and safety, as well as questions of discipline, order and organization are taking on paramount importance in the scientific and technological revolution's future course." The issues of assuring reliability and safety are especially critical in the development and operation of major national economic complexes. At the editors' invitation the well-known Soviet scientist Academician B. Ye. Paton, president of the USSR Academy of Sciences and twice Hero of Socialist Labor, reflected on these problems.

[Question] Boris Yevgenevich, why is the traditional approach to evaluating reliability, which is quite well suited to the production of individual components and devices, being seen as inadequate when major complexes are involved?

[Answer] It is because the larger the complex, expressed figuratively as a greater contact with and effect on the environment, the tighter the connection between its various components and the more extreme the consequences of failures and malfunctions.

Under the conditions in which it must operate this type of complex cannot be isolated from the external environment. For example, a transportation network must operate during a fire or extreme cold and continuously deliver cargos even during natural disasters. A machine tool, to take an example, has other requirements, such as high productivity and precision. If it fails to work as a result of a fire hardly anyone would get the idea of blaming the designer--he could not provide for his creation working while everything around was in flames. But what if a fire causes an accident at a chemical plant, resulting in the release of dangerous substances which contaminate the surrounding flora

and fauna? Here it would be completely logical to question the designers. Their task is foresee such a situation, to envision all the means needed to prevent it and to provide measures to handle the consequences should it occur.

On the other hand a major complex is always an encroachment on nature. We cannot always foresee its ecological consequences in all situations. Even where we can we do not always consider them. Thus, we continue to multiply examples which very well illustrate F. Engels' warning that each victory over nature "... has, at its first level, the consequences we planned while at the second and third levels there are completely different and unplanned consequences which often destroy the significance of the initial ones."

Fertile lands are flooded by water reservoirs, covered by spoils piles from open-pit mining enterprises or by air pollution from chemical and metals manufacturing, and cut by rights-of-way for high-tension electrical transmission lines, petroleum pipelines, highways and railroad tracks. All of this is payment for our sometimes pyrrhic victory over nature. Often it just a first installment rather than the payment in full. In fact, this type of "improvement" is only the beginning of a long chain of consequence, each link of which will repay us in its turn.

The total price of a major complex is in no way defined by the direct costs of its creation alone. The ecological losses which cannot be avoided when it is included in the "ecoindustrial" system must be brought into the accounting. Thus, reliability in this type of facility, even during normal, incident-free operation, must inevitably encompass the task of safeguarding all elements of its environment which must be protected from the effects of the facility. In other words, the reliability of a major national economic complex means reliable protection of the surrounding environment, including of course the people who operate the facility and those who live in its vicinity.

This is understandable inasmuch as such a facility may have a huge energy potential, a high concentration of dangerous radioactive or chemical substances, large heat or water resources or any combination of these factors. A loss of control over any of these nearly always means damage in both human and economic terms.

This in itself fundamentally changes the approach to evaluating reliability. While the determination of a reliability level in a component or even a large system usually begins with the thought that a further increase is not advisable--because it is easier to change or repair the unit--, the criteria change when applied to complexes. The typical evaluation of a "0.001 probability of system failure in a year" cannot be arranged because, as stated ironically by system engineers, "even the least probable event must occur sometime." In such a case the ecological and medical consequences of an accident could far exceed all the costs of creating and operating the complex.

Here there is no path beyond striving for absolute reliability and exclusion of even the possibility of individual failures. The very possibility of contemplating such failures is a sign of an unreliable design solution. When the design is being established either the reason for failure must be removed or special means must be planned to eliminate any dangerous consequences of

such a failure. If neither of these actions is possible--i.e., too expensive--then at the very least the project's implementation must be delayed temporarily.

This applies especially to global projects in which a loss of control would threaten the destruction of a major population or even mankind itself. Projects involving weapons of mass destruction are an example of this. Without mentioning their fundamental antihuman orientation, these projects should not exist simply because of their enormous threat of danger.

While absolute reliability unfortunately cannot be obtained in a typical major complex, we must strive for this level of safety, often in the face of the highest expenditures. This is because economy here can lead to devastating losses.

[Question] Let's consider a project as fantastic as converting sunlight to electrical energy on a satellite and transmitting this power to earth. I say "fantastic" although every part of the process is theoretically possible. Right now this is being examined as a alternative in the solution of the energy problem.

Imagine a satellite permanently stationed 36,000 kilometers over a given point on the earth. Using deployed solar battery "arrays" it collects the sun's tremendous energy and transmits it to receiving stations on earth in the form of microwave radiation. We will assume that all the necessary equipment has been developed and that the project is feasible.

Now come the reliability problems. In fact, there is a "fiery link" passing through the atmosphere from the satellite to the earth. It must be insensitive to storms, frosts, air currents and temperature variations since the energy supply's continuity will depend on this essential fact.

But this happy picture dims if the "link" itself begins to burn the atmosphere, spawn cyclones, cause radio interference and so on. Finally, it is frightening to contemplate even a single failure in the chain made up of the satellite, transmission system, focusing equipment and receiving station. Such a failure could lead to hundreds and thousands of megawatts of energy running out of control and literally cutting all living and non-living things to shreds in a large area.

So, should such projects be avoided?

[Answer] They would be hard to avoid if energy resource depletion threatened us with global blackouts and freezing. But their adoption would mean consideration of reliability and "looking"--not once, but carefully and repeatedly--before we "leap."

[Question] But couldn't new, unconventional methods of "failure-proofing" major complexes provide insurance even against isolated failures?

[Answer] At the very least they should. I am attempting to formulate some suggestions which should help to achieve this goal.

The first of these suggestions comes into play prior to the design phase and is based on the premise that the safest complex is no complex. At first glance it sounds simple: "Before starting any project let us think, is there no way around it?" We need only recall the discussion recently concluded with success on the project to turn the northern rivers. The issue aroused passions for some time. However, at one point all of these efforts could not even be called a discussion because a "change of opinion" was underway in some quarters. Finally the Politburo of the CPSU Central Committee adopted a decision to stop all work on this project. The good guys won this time but, unfortunately, this is not always the case.

A lowered Lake Sevan, where attempts to raise its level are being made at tremendous costs, a disturbed ecosystem in the Caspian Sea's Kara-Bogaz-Gol Gulf and a Baikal cellulose/paper mill which even today is suffering from raw material shortages are only a part of the list of unnecessary national economic complexes. They not only threaten our ecological security, they do not even fulfill their immediate economic objectives.

[Question] What about the leaders who accepted responsibility for these decisions and brought them to life? Didn't they know about the consequences?

[Answer] Well, I won't be the judge of whether they knew or did not know. In any case it can be shown that they made these decisions under the strongest pressure from bureaucratic, and often extremely expedient, interests. To put it mildly, the scope of discussion was severely restricted.

[Question] We feel some bureaucratic pressure even today. Let us take a question as current for the Ukraine as the construction of the Dunai-Dnepr aqueduct. I don't want to make any predictions at this time. Right now at this academy a special commission is charged with a thorough evaluation of the project.

But this is the interesting part. As yet, neither the project nor its technical and economic specifications (TEO) have been approved. State experts from USSR Gosplan have started on the finishing work and the builders have already begun preparatory work. In other words, the activity on the part of the interests involved leaves no doubt as to the outcome.

[Answer] At the same time there are growing, justified doubts about the need for the project itself. Total water demand has more than doubled in the republic during the last 25 years. According to recent suggestions it should grow another one and a half-fold by the year 2000. Satisfying this growing demand would require the use of all the Dunai's water.

But must we accept this growth in demand? In fact it is the result of an expansive approach to the consumption of this most important national resource, encouraged by the illusion that it is free.

The experience of other indu
approximately in the 1960s, their water consumption demand ceased to grow, in spite of industrial development and an increase in cultivated land area.

There is no paradox here. It's simply that water-sparing and even waterless technology is being increasingly used along with water recycling and drip irrigation. In other words, intensification produces savings.

For example, when water usage standards were introduced in Sweden the cellulose/paper industry experienced a 10 to 20-fold reduction in water consumption. This is the power of economy and intensification working together.

But isn't that our situation today? Besides, in spite of the growth mentioned earlier isn't our relative water usage less than that of other countries? Unfortunately it is higher, often several times higher. It is no surprise that the decision which cancelled the feeble attempt at reallocating the northern rivers called for a 15-20 percent decrease in the national economy's water consumption rather than an increase.

The next thing is to avoid "out of plan", spontaneously generated complexes.

[Question] Please explain what you mean.

[Answer] We all know how to answer when a child asks, "Why aren't you supposed to pick flowers from the garden?" Unlike infants, we all understand very well what happens when everyone sets out to pick one flower from a small garden. But what happens to that understanding when we are faced with rivers, forests, fields and meadows? We don't seem to be able to adjust to the concept that now our entire earth is one garden and if everyone starts to pick a flower...

At one kolkhoz fields were extended almost to the very edge of a river in an effort to expand pasturage. Since the banks were not protected the river quickly began to fill in, silt up and finally dry up. Just think, a river, then not a river at all, just a creek or stream. Frighteningly enough, this is a typical response in these cases. And this is how the neighboring kolkhoz and then one kolkhoz after another behaves in a search for cropland.

This is how a complex starts. A complex which is not created by any one entity, is not very efficient and ultimately destroys small rivers. Now there are huge areas which do not collect moisture from the atmosphere to feed large rivers and reservoirs. Many small streams need help and there are some that are beyond help. There is no one to turn to. No one planned this and no one is responsible. Each entity plowed up its "own" river, so to speak.

[Question] There's more. Irrigators in the southern Ukraine are pouring out water. Irrigation equipment is operating nearly around the clock, rain or shine. How could it be otherwise? Irrigators' earnings are often a direct result of the quantity of water used. How can it be surprising that we are beginning to find water in short supply? This is the background for projects like the Dunai-Dnepr aqueduct. These plans are dreamed up without even considering that the land itself cannot handle this much water. Next there is nowhere for the water to go--remember the clogged rivers. Now the ground water level begins to rise in vast areas. In hundreds of thousands of fertile hectares with scores of populated areas the ground water level has risen

nearly to the surface. Foundations are cracked, cellars are flooded, structures have collapsed structures and plant and tree roots are rotting. In other words another spontaneously generated "flooding complex" has again brought about the most serious economic consequences.*

[Answer] We must oppose these types of "complexes." Moreover, we must learn to avoid them!

[Question] Let us return to planned (no quotation marks here) national economic complexes. What are the most urgent requirements for their reliability and safety?

[Answer] Everything used or produced at the complex must be examined at the design stage, including raw materials, products, energy, heat, water, etc. All of these items must exit into the environment only as finished products (this also includes intermediate products destined for subsequent processing). Everything else must be returned for reuse. This would seem to be a simple, well-known principle: a good manager wastes nothing. The facts, however, are completely different. As the unfortunate results irrefutably indicate, accumulated but unused, or even not completely used, resources represent more than lost profit and a warning signal, they are a probable source of danger. As a rule these resources are inadequately monitored and the consequences can quite simply be unpredictable.

[Question] A new school building near a major electrical power plant collapsed. Luckily it was at the end of summer vacations so no children were injured. It happened because the power plant was built on unstable limestone*bearing soil. The site was poorly selected and the structure's integrity was lowered as a result. In this case, hot water, a by-product, was only partially cooled in cooling towers. It entered the soil and rapidly initiated the formation of sink holes. The limestone began to dissolve and voids appeared underground. One of these was almost the cause of a tragedy.

[Answer] And how many accidents involve the flammable piles at lumber mills or chemical plant by-products? How much land disappears for long periods and sometimes forever under mine spoil piles, under the ashes from thermal power plants and under the surplus area of water reservoirs without adequate embankments?

We are now approaching the other side of the problem so to speak. A complex should not have any unnecessary items, including excess area.

Let us take a look at the Kiev Reservoir for example. It supplies water for agricultural and industrial enterprises, permits navigation, etc.

Why is it so big--almost 1000 square kilometers? At one time there was a plan to bank up this reservoir, but a decision was made to wait when the costs were added up (it seems the cost amounted to tens of millions of rubles). So, they saved money.

[Question] What was the result?

[Answer] Well, first the most fertile marshlands and coves were flooded. Second, the reservoir became shallow and in summer the water became very warm. Then the abundant organic residue of flooded plants on the bottom began to grow rapidly. Vast quantities of the unfortunately well-known blue-green algae appeared. They contaminated the water, starved out the fish and made a number of sites unsuitable for use by workers for recreation.

I believe that the cost of crops not harvested in the ensuing years alone has many times exceeded the millions not spent on the project at the time. Of course now that we understand, the cost of building the embankments is much higher. There needs to be preliminary dewatering, work in marshes, soil improvement and the establishment of an agricultural infrastructure. All of this is very costly. Nevertheless, this is what must be done. At least a part of the Kakhovka Reservoir, the former Konka Rapids, is in the same situation and undergoing this type of work.

[Question] Apparently an overall scientific approach to a project's scientific and technical specifications should help to avoid these types of errors. But today isn't it hard to find any project, even the smallest, in which scientists are not involved? What is going on?

[Answer] Unfortunately, their efforts and the pure scientific approach are not always one and the same. The three links of the chain are: analysis of high-quality data, development of proper recommendations and adoption of appropriate decisions. Each of these links has its vulnerabilities.

Let's start with the first. We are already used to the fact that information is always inadequate. Does it have to be? Yes and no.

In fact when you begin to "interface" any project with specific conditions, to a specific site let's say, the data on some geological features, on some aspect of vegetation or the water balance or on some other characteristic are nearly always inadequate. The first restriction which must be reconciled in this instance is that time and resources cannot be spared in the search for these data.

The power concentrated in mankind's hands today is so great that to put it in action without examining all the consequences, to "work in the blind" so to speak, is simply criminal. Therefore, one must be prepared for the fact that the preliminary phases of a project will cost as much as or more than its implementation. Knowledge is expensive but a lack of knowledge is even more expensive! This is the picture of modern design and it must be examined with open eyes.

But will this always be the case? This is debatable. If in theory we can obtain comparatively exhaustive information from nearly any source then it would probably be a good idea to collect it for the entire surface of the planet, store it in a data bank and continually update and use it as needed. Of course this work requires tremendous capital expenditures, but think how much effort and work would be saved as a result!

This type of experience already exists. In handling the consequences of the Chernobyl accident we succeeded in linking the capabilities of the latest computer equipment with data on the region around the nuclear power plant stored by various agencies. The task was a difficult one. Under ordinary conditions it would have taken years to solve this problem whose aspects included data correlation, a uniform system of result displays and the rejection of distorted information. Nevertheless we got to work and the results were remarkable.

Maps of various sectors of the affected region began to appear before the eyes of specialists from various disciplines gathered before the screens of Delta mega-minicomputers. And what maps they were! By examining them one could learn everything about every point, including the type of vegetation, soil composition, ground water level, terrain relief and much more. With the use of these maps it became much easier to make the necessary decisions: engineers found a way to talk to physicians and physicists could talk to hydrogeologists.

Even more impressive were the results of working with the so-called "situation room." Here various processes were interactively "played out" on a dynamic model of the Kiev reservoir and the consequences of the various engineering solutions were displayed almost immediately on a large screen.

[Question] In my opinion these are problems of the second link--the development of appropriate joint recommendations. As I understand it, scientists can differ according to their level of knowledge, they can belong to different and even opposing schools of thought and they can protect the positions of their departments, areas or other interests. Many calls are issued for objectivity on the part of scientists and appeals are made to the ethics of workers in the field of science.

[Answer] Of course it would be very nice if all scientists fully respected their civic duty and it is very unfortunate that this is not yet the case.

Although not to ignore ethics, it seems to me that the solution lies elsewhere. But any scientist can sincerely go astray and confuse the decision makers. The process of making and harmonizing group recommendations for major national economic complexes must be improved so that errors are eliminated insofar as possible. For this all doubts must be considered and the opinion of all participants in the discussion must become unified. The most promising means of achieving this is through simulation modeling based on interactive expert systems.

A great deal of time can be spent exchanging correspondence, especially official letters, explaining one or another question and endless arguments can take place on overall subjects without achieving a uniform opinion. However, it is very difficult to oppose a graphic model. Technology is a concrete thing and with an adequate model of the complex being designed you can easily see the unavoidable consequences it will produce.

Under these conditions--which are most often resolved in the situation room--it is very difficult to unjustifiably defend outside interests and it is much

easier to eliminate even sincere fallacies. To be sure, creating these models is complex and they are expensive, but this is a case where today's savings could become tomorrow's losses.

Therefore, development of an appropriate simulation model is a prerequisite for achieving of high reliability in the construction of a major national economic complex. As the model is refined and improved it will follow the complex through its design, construction and operation stages.

What about the third link in the scientific approach to design: "making the appropriate decisions?" This is where we sometimes encounter the worst of the unexpected.

[Question] The necessary information has been collected and analyzed. Highly trained scientists and specialist have finally reached a single opinion. The competent experts have endorsed the decision to construct, and then...

The local authorities come into play. What's this doing here? By the way, our construction base is 50 kilometers from here. The work force is over there, where living conditions are better. So, that's where construction is started.

This is exactly what happened when the school building went up next to the power station we mentioned earlier. This occurred in spite of repeated warnings from scientists that it shouldn't be built on limestone soil and their suggestion of a suitable alternative site. However, their recommendations were not heeded.

That is what is most frightening. Certainly science still cannot do everything. There are situations with unknowns in which scientists cannot make reliable predictions and recommendations. But where there are recommendations ignoring these is the worst type of irresponsibility.

I have already mentioned the erroneous decisions made in connection with the northern rivers, Lake Baikal and Lake Sevan. Other examples can be cited. All of them have a common factor: there were always scientists who actively, and as subsequently proven, appropriately spoke out against these decisions. They not only spoke out, in each case they proposed different, better and more reliable alternatives. However, sector management more often than not simply did not consider the opinion of these specialists. Sometimes they made every effort to silence them.

The decisions were made in secret, without outside assistance and with no publicity, which in my opinion is the main reason for such situations arising. Openess is now becoming an essential part of our life and the situation is changing. The time of arbitrary decisions made for short-term advantage and dearly paid for later has passed. At the same time we, Soviet scientists, are increasingly responsible for the adequacy, reliability and safety of the greatest decisions on the national economy.

[Question] Facility safety must be incorporated in the design stage. This is self-evident. But apparently if the designed-in means of avoiding malfunctions, failures and accidents are not understood by the facility's

operators and if their function is not strictly regulated there will be frequent and tragic situations about which people in the past have said: "It looked good on paper but they forgot about the ditches."

[Answer] Let's talk about these "ditches" into which even the best design solutions have sometimes literally fallen. This happens precisely because we have not made boldness a rule. We do not examine these very "ditches" and develop a habit of circumspection. Of necessity, this in turn is not to be just confined within rather strict legal boundaries but placed on a scientific basis.

First let me take up the legal side of the question.

Speaking frankly, I am convinced it must rest upon a restriction principle; the judicial prohibition of any deviations from an approved design. Partial changes are to be allowed only as exceptions to the rule, must not affect key features and must above all not influence the safety of the facility as designed. All types of disciplines--from purchasing to management--must rest firmly on this base. This is certainly good management and arises from the fact that any manager responsible for organizing the implementation of a project has a mandate from the state for the sole purpose of vigilant performance of this task. Any change in the design can only come from the designers' area of expertise.

Here even the smallest of compromises is prohibited. The spirit of this fact has already been repeated 'ad nauseam'. For example, the design calls for schedule 500 concrete and schedule 300 concrete is delivered. Neither the foreman nor anyone else, not even the highest manager is authorized to use it without at least obtaining a designer's clearance. Only the designer can know what the critical consequences of such a change can be.

Nevertheless we not infrequently encounter dangerous design deviations which you have already termed not accidental. They are primarily dangerous because they appear to be so intentional. Usually it all starts because most building is not recorded for one reason or another in the initial estimate or there are not enough construction materials and manpower. This initiates an unauthorized process of "simplifying and cheapening" the complex.

In this process the opinions of tens and hundreds of specialists are often ignored. So, unnoticed and without much discussion, the contributions of competent specialists are removed from the design in the course of an hour. With courage worthy of better application, people make decisions to which they have no right. As a result, when emergency situations do occur, we may find ourselves--and unfortunately sometimes do find ourselves--inadequately prepared.

[Question] It would seem that everything should be done to avoid emergency situations, and once they arise, to ensure that they are handled quickly and without serious consequences. To achieve this the most critical components are redundant, blocking systems protect components from improper operator actions and special sending units monitor temperature, gases and other parameters, activating the appropriate means of handling the situation when it arises.

[Answer] But airplanes crash, ships collide, fires break out and explosions occur and these are not "acts of God." Each time special boards find very down to earth causes behind the accident. These include equipment failure, human error and unexpected external influences. Therefore, while always intensifying our efforts to prevent emergency situations and anticipating the possible as well as the impossible in order to avoid their occurrence, we must still continually be prepared for the fact that they will take place.

I don't think you can close your eyes to emergency situations. Their probability and improbability must be predicted and they must be modeled. A special program should be used to train personnel on such models. In that way suddenness would not be as sudden and the unfamiliar would be more familiar.

As a rule, an accident in a large system is only the end of a long or short chain of sucessive events. The sequence starts with some little-noticed violation of normal operating practices. The designer's job is to study these sequences and determine the means of breaking each chain appropriately. In this way, whatever the accident's cause, it will not lead to tragedy.

Of course, operators must also visualize the probable course of events. The important thing here is to understand what is to be done at each specific moment. A lack of time will not permit a long period of thought; accident avoidance must be a nearly automatic practice. Training on models is the way to develop this automatic response.

Models should be used to study the sources of emergencies and their variations, from burned-out microcircuits to natural disasters. The responses of operators to all possible alarm signals should be honed to an automatic level on models and special trainers.

Models, test beds, trainers, multiple redundant systems and protective equipment are all part of a major facility's reliability and must be an integral part of the design.

But since they do not play a direct role in the manufacture of the basic product, many managers still have not shed the old attitude that they are of secondary importance. This is fundamentally wrong. True capacity and safety in a major engineering facility will only be achieved through a thorough examination of its reliability and lack of reliability.

In answering the editors' questions I have left many aspects of this problem untouched. This is natural, it is easy to discuss only what you know well. Still there is no theory of reliability for major national economic complexes. Its development has only begun. But practice continues to impose urgent demands during its development and, as we know, these demands do more to advance science than dozens of universities.

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WAYS TO SHORTEN RESEARCH-PRODUCTION CYCLE PROPOSED

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 8, Aug 86 pp 83-92

[Article by Doctor of Economic Sciences B. Zaytsev, professor of the Academy of the National Economy attached to the USSR Council of Ministers, under the rubric "Problems of Scientific and Technical Progress": "The Shortening of the 'Research-Production' Cycle"; capitalized passages printed in boldface]

[Text] The 27th CPSU Congress set imposing tasks on the acceleration of scientific and technical progress and the increase of the role of science and technology in the qualitative transformation of productive forces, the changeover of the economy to the path of all-round intensification, and the increase of the efficiency of social production. During the 12th Five-Year Plan it is necessary to change over to the output of systems of machines and complexes of technological equipment, to increase the pace of the updating of the products being produced, and to increase by 1990 the share of the production of new equipment to not less than 13 percent of the total volume of items of machine building.

The solution of such problems requires already in the immediate future the implementation of a set of measures, which are aimed at the increase of the role and responsibility of the USSR State Committee for Science and Technology and the USSR Academy of Sciences, the increase of the level and effectiveness of sectorial science, as well as the development of the creative scientific and technical work of workers and the improvement of inventing, patent, and license work. On the other hand, the successful accomplishment of the tasks posed by the congress in many respects depends on the shortening of the "research-production" cycle.

At present the time from the start of applied research, which is performed for the most part at sectorial scientific research organizations, to the industrial production of new machines and materials and the assimilation of technological processes comes on the average to 5-7 years. Here insufficiently efficient equipment frequently reaches practical application. More than 800,000 innovations are introduced annually in industry. However, on the average each of them provides a decrease of the social costs of production of not more than 6,500 rubles and does not lead to a significant increase of labor productivity. As a whole per year about 500,000 workers are freed, that is, less than 1 worker per innovation.

Many inventions, which are fundamentally new technical solutions, are also being introduced in production. At the same time they are often aimed at the improvement not of the basic characteristics of the equipment being developed, but of auxiliary, "service" elements. This is confirmed by the fact that only 4 percent of the inventions being introduced provide a significant (100,000 rubles and more) decrease of the social costs of production.

The practice of attaching the accomplishment of the work on the stages of the "research-production" cycle (scientific research, development, designing, introduction) to the existing organizational structure of the management of the national economy (scientific research and planning and design organizations, associations, and enterprises), on the one hand, objectively leads to a large time gap between them and, on the other, orients the performers of the work toward the achievement of intermediate results which do not reflect the national economic efficiency. Moreover, the procedure of the planning and stimulation of scientific research and development and the use of their results, which has formed in the sectors of industry, also does not always contribute to the shortening of this cycle and the increase of the technical level of the new equipment being developed.

The analysis of the instructions and procedural principles, which are in effect in the sectors, shows that the "research-production" cycle as an object of planning is broken down among numerous planning forms which reflect the assignments of individual stages of the cycle, which are disconnected in time. There is no technology of interconnecting these forms into a unified set of assignments which are aimed at the ultimate goal. Therefore, it is impossible even after the approval of the plans to obtain information on the period from the start of the work to the materialization of the idea in production.

The shortening of the "research-production" cycle depends on the solution of many problems of the organization and functioning of the system of the management of scientific and technical progress, which are different in their essence, direction, and influence on the conducting of scientific research and development and the introduction of their results. Let us examine the most important of them. These are first of all the problems of the improvement of planning, the organizational forms of the integration of science and production, and stimulation.

The thematic planning of scientific research and development, as well as the introduction of new equipment is carried out for the most part "from below," in accordance with the suggestions of scientific research institutes, planning and design bureaus, associations, and enterprises. The majority of the assignments of the comprehensive scientific and technical programs, which are approved by the State Committee for Science and Technology, the USSR State Planning Committee, and the USSR Academy of Sciences, and the five-year and annual state and sectorial plans are formulated according to the same principle.

After approval of the assignments the superior organs of management monitor the expenditure of financial assets. Here the complete use of the allocated resources is regarded as the fulfillment of the plan. The saving of financial

assets is regarded as a violation of planning discipline and leads to administrative sanctions. In practice different versions are possible. For example, a scientific research institute overstated the estimated cost by mistake or completed the work with the required technical and economic indicators of the equipment being developed ahead of time (with the correctly calculated expenditures of resources and time). However, in both cases it will be punished. The saving on the estimated costs of scientific research and development in conformity with the instructions in effect in the sectors is established within the range of 2-10 percent. It is possible to state that the scientific research institutes and planning and design bureaus, which have at the stage of the formulation of the thematic plans the opportunity to overstate the estimated costs of operations, are not interested in the saving of resources when performing research and development.

The estimated cost of research and development in many respects (in nearly direct proportion) depends on the time of their conducting. Thus, the prevailing expenditure mechanism of financing, in addition to the inefficient, economically unjustified expenditure of national economic assets, leads to the lengthening of the time of the implementation of the "research-production" cycle.

In recent times publications on the effectiveness of the financing of scientific research and development on the basis of the system of settlements for work, which has been completely finished and accepted by the client, have appeared in the press. The decrease of the level of unfinished work and the reduction of its duration are cited as a positive result. However, such a conclusion raises objections. The system by its essence and economic influence compels scientific research institutes and planning and design organizations to work on minor themes and to include in the plans operations which are being completed, as a rule, during the year. Under these conditions it is difficult to expect the development of fundamentally new equipment. Moreover, short-term operations, on the one hand, significantly facilitate the financial status of scientific organizations and, on the other, guarantee it a larger amount of stimulation funds as compared with the conducting of important, highly efficient research and development.

The suggestions on the self-sufficiency of sectorial scientific research institutes and planning and design bureaus also raise valid objections. Here it is important to take into account that only independent organizations can be changed over to cost accounting, especially full cost accounting. As will be shown below, in connection with the improvement of the organizational structures of management only main scientific research institutes, the number of which is not that large, will be independent. Moreover, their main task consists in the determination of the scientific and technical prospects of the sectors, the creation of a scientific reserve, as well as the implementation of a unified scientific and technical policy on the basis of the coordination of the activity of the corresponding scientific subdivisions of the ministries. In all likelihood, these functions should be performed not on the basis of economic contracts, while payment should be made not for the completely finished work.

The prerequisites for the planning of the "research-production" cycle in a unified set of specific assignments and indicators appeared as the result of the generalization of practical experience and the development of procedural approaches. What is meant is the supply orders which are formulated in a number of sectors of industry. Their distinctive feature consists in the fact that on the basis of the ultimate goal--the production of the first commercial batch or the assimilation of a technological process--the assignments with respect to all the stages of the cycle are specified with the reflection in them of the amount of work, the time of its fulfillment, and the performers. This enables each performer to prepare in advance for the performance of the work and to organize interaction.

Practical experience has confirmed the great effectiveness of such plans. At the same time the shortcomings are also obvious. They consist in the following. First, the supply orders are prepared for the most part for an individually taken theme, which does not follow from the prospects of the development of the sector and is aimed at the solution of the local problems of individual associations and enterprises. Second, the proposal of the scientific research institute or production association is the basis of the supply orders which reflect the assignment of the ministry. If the assignment comes from above, in most cases for various reasons it runs into the reluctance of the performers to implement it. Let us examine examples.

The main task of scientific research and planning and design organizations of the petroleum industry consists in the conducting of long-range large-scale studies which are connected with the development of plans of the working of petroleum deposits. It seems possible to incorporate in them all the latest scientific and technical achievements and during the working of deposits to provide millions of tons of additionally produced petroleum with the minimum social expenditures. In other words, the economic impact is estimated in the millions of rubles, but the real saving will be obtained in 10-20 years.

In this connection the statute in effect in the Ministry of the Petroleum Industry groups such research with operations which do not yield an economic impact. The maximum amount of stimulation is specified in the amount of 20 percent of the wage fund which was actually spent on its conducting. This does not stimulate the developers to increase the quality of the plan and to decrease the capital investments in its implementation and restrains their desire to engage in long-range research, since in case of a real saving from the introduction of the results they will receive a much larger incentive.

But the problem is not that difficult. For its accomplishment it is necessary to use the prevailing Method of Determining the Economic Efficiency of Use in the National Economy of New Equipment, Inventions, and Efficiency Proposals and the sectorial instructions which have been formulated on its basis. In conformity with their provisions the amount of the annual economic impact, which will be obtained in the immediate future, with allowance made for the time factor can be reduced (converted) to a factor of stimulation. This will also be the real saving which was obtained from the implementation of the plan. It is necessary to note that such an approach is scientifically sound and can be used with respect to the efficiency of any innovation.

Here is another example. Scientists developed a new instrument which makes it possible, without interrupting the drilling of petroleum wells, to adjust its direction promptly. Prototypes of the instrument underwent service tests at boreholes of Bashkiria, Tataria, and the Orenburg area. The use of the innovation provides a saving of up to 40 hours per well. In other words, it is possible to drill four wells in the time which was previously enough only for three. Taking into account the scale of drilling, the use of the new instruments will contribute to the successful accomplishment of the tasks of increasing petroleum production and decreasing the expenditures on preliminary operations.

The State Committee for Science and Technology and the Ministry of the Petroleum Industry assigned the production of the innovation to the Elektron Production Association. However, it is burdensome for it and requires additional efforts on the delivery and installation of the necessary equipment. Therefore, the production association for 3 years has upset the decisions of superior organizations on the production of highly efficient equipment, but has probably been considered a leading one and has received bonuses.

The dictation of the producer is placing the developers of new equipment in the position of a petitioner without rights and is prolonging the time of its introduction. This can be especially dangerous in case of the broadening of the independence of production associations and enterprises.

The role of the planning of a number of indicators, which are conducive to the shortening of the "research-production" cycle and have a substantial influence on the increase of the efficiency of the activity of the primary units of social production, has been unjustifiably belittled in recent years. It is a question first of all of the economic impact from the implementation of scientific and technical measures and the basic indicators of the technical level of production, which have been introduced in the system of the planning of the national economy.

Practical experience attests that specific difficulties (especially of a procedural nature) exist in the planning of the economic impact from the implementation of scientific and technical measures. It is very difficult to distinguish the increase of the actual profit, for which a specific measure accounts and which is obtained as a result of the effect of a set of different factors, including the expansion of the scale of production, the improvement of its structure, and the change of prices. Many difficulties are connected with the determination of the basis of comparison and, more precisely, with its absence.

At the same time some experience exists in the formation of the procedural approaches of the planning of the economic impact and their practical use. It is based on the possibility of drafting a plan of the introduction of new equipment over the entire technological cycle of the production of the product. This provides a number of advantages as compared with planning which is carried out with the use of traditional methods. Such an approach makes it possible to encompass completely all the measures, which are connected with the planning of new equipment and the acceleration of its introduction, and to

achieve the highest cost accounting indicators for this enterprise. The calculation of the amount of equipment, which is necessary for all the technological processes and their stages, becomes practicable.

The shortening of the "research-production" cycle in many respects depends on the continuity and comprehensiveness of the planning of operations with respect to all the stages of the development and introduction of new equipment. The practice of the planning of scientific research, as well as the preparation of sectorial scientific and technical comprehensive programs confirms the possibility of the implementation of the idea of the COMPREHENSIVE PLANNING of operations with respect to all stages of this cycle.

The system of the comprehensive planning of the "research-production" cycle is in effect in the Ministry of Power Machine Building. Here a supply order, in which all the operations on their use, which are necessary for this, are reflected, is opened for each item of new equipment, which is being developed. Such was also the case in 1979, when the need for the development and introduction of a computer-aided design system of heat exchangers for thermal and nuclear plants appeared. Assignments on the performance of the corresponding work for four scientific institutions and associations of the sector were envisaged in the supply order which was approved by the ministry. Moreover, for the purpose of increasing the technical level of the system the Krasnyy kotelshchik Production Association, the main organization for its development, on the basis of economic contracts enlisted in the solution of theoretical problems an academic scientific research institute and a higher educational institution.

In conformity with the assignments of the supply order in 1981 predesign research, the formulation of the technical specifications and technical assignment (for the computer-aided design system and the construction section), as well as the introduction of the first phase of the automated archive were carried out simultaneously. In 1982 the detail designs for the computer-aided design system and the construction section were drawn up simultaneously, and the second phase of the archive was also introduced.

The year 1982 was the period of the drawing up of the working documents, the preparation of the premises for the system, and the acquisition of the necessary equipment. The timely performance of this work made it possible during 1983 to carry out the installation and adjustment of the equipment and to introduce (finish up) the system as a whole.

Thus, the supply order, which was delivered in 1979 to all the performers, envisaged the simultaneous performance of the operations, which are included in the various stages of the "research-production" cycle, as well as made it possible to coordinate the actions of the performers and to prepare in advance for the accomplishment of the assignments. As compared with the discrete stage planning of the development and assimilation of new equipment this shortened the development and introduction of the system by not less that a year. The total amount of work came to 1.39 million rubles, while the annual economic impact came to 1.95 million rubles. At the same time the need for the improvement of the methodology of the formation of the set of assignments,

which are aimed at the achievement of the ultimate goal, and the strengthening of the directive nature of planning is obvious.

At present the standard procedural statutes and the legal regulation of the planning of work with respect to the stages of the "research-production" cycle are reflected in a large number of instructions, methods, and legal acts, which are not always and not in everything coordinated with each other. For the purpose of shortening the time of the introduction of new equipment in the national economy it is necessary to eliminate the formal bureaucratic regulation of the procedure of drawing up the plans of research and development and using their results and to decrease the number of consultations. In individual sectors of industry the process of including research and development in the plan is dragged out for up to 15 months. Of course, instructions and statutes are necessary, but their basic task lies in the assurance of the unity of the procedural approaches and forms of planning and in the orientation toward its comprehensiveness and the coordination of the assignments with respect to all stages of the "research-production" cycle.

The strengthening of the directive nature of the planning of new equipment presumes the improvement of the functions of ministries. The main thing, on which ministries should concentrate their activity under present conditions, it was emphasized at the 27th CPSU Congress, is the determination of the strategy of scientific and technical progress in the sector and the prospects of its development, the increase of the overall level of economic work, and in the end the complete meeting of the needs of society for products.

Scientific and technical comprehensive programs, which are formulated for 10-15 years, can be a tool of the accomplishment of such tasks. On the basis of the twofold goal of scientific and technical progress, which fundamentally unites the need for the improvement, on the one hand, of the technological processes of the production of material wealth and services and, on the other, of this wealth and these services themselves, it seems important in each ministry to have two such programs. The first of them is aimed at the increase of the technical level of production and includes the development and introduction of fundamentally new technological processes and the retooling and renovation of enterprises. Its assignments require coordination with the other program--the development and production of fundamentally new types of products.

The formulation and implementation of the programs should be carried out not only under the supervision of the ministry, but also with the direct participation of its corresponding subdivisions and specialists. It is necessary to include the assignments of the programs in a priority mandatory manner without a change of the technical and economic indicators in the five-year plans of scientific research institutes and planning and design bureaus, associations and enterprises of the ministry. This will be the basis for the timely preparation for the start of work on all the stages of the "research-production" cycle and the elimination of the temporary gaps between them, as well as for the allocation of the necessary manpower, financial, and material resources.

For the formulation of such programs it is important for the ministries to have scientifically sound forecasts of the development of subsectors for the coming 15-20 years.

One of the basic factors of the acceleration of scientific and technical progress and the increase of the technical level of new items is the integration of science and production. In socialist society it has become an object of management at the state level. In recent years new organizational forms of the contact of science, technology, and production have appeared. The most effective ones of them are scientific production associations and production associations. Their basic advantage lies in the real and significant shortening of the "research-production" cycle.

About 250 scientific production associations are now operating in industry and other sectors of the national economy. However, in most cases the proper conditions for their activity have not been created for them. As a rule, they have organizational administrative, but not management unity. Therefore, as was noted at the June (1985) conference in the CPSU Central Committee on questions of the acceleration of scientific and technical progress and at the 27th party congress, it is very important to give new impetus to the development of this form of the contact of science with production.

The revelation of the advantages incorporated in it is being hindered first of all by the accepted practice of planning--it is carried out in conformity with the structural subdivisions which belong to the association. The assignments are established in an individualized manner for scientific research and development, pilot and series production. Moreover, pilot plants and series-producing enterprises have the same set of indicators. As a result the pilot experimental operations, which are performed at enterprises, do not exceed 10-15 percent of the total volume of output. And this is given the obviously inadequate level of such operations for the normal process of the development of new equipment.

The isolation of the structural subdivisions of scientific production associations stems from the fact that the scientific and technical (or technical) administration of the ministry plans research and development, while the economic planning administration plans the activity of pilot and series-producing subdivisions. As a result the plans of the development and assimilation of new equipment, as a rule, are not coordinated and are not balanced.

The lack of balance of the capacities of the structural subdivisions belonging to scientific production associations is also not conducive to the increase of their efficiency. All the enterprises of a subsector have been included in many associations without regard for the scientific and technical, technological, or item specialization. This has the result that they level the role of science and suppress organizationally and economically the development of scientific research and development. Thus, 8-11 sovkhozes with up to 10,000 workers are included in the agricultural scientific production associations of the Moldavian SSR, while at the main scientific research institutes there are not more than 200-250 staff members.

One of the conditions of the successful functioning of scientific production associations as unified economic complexes is the planning of their activity in accordance with the sector of the national economy "science and scientific service." (Footnote 1) (Now, with minor exception, planning is carried out separately: scientific research and planning and design subdivisions--in accordance with the indicated sector, and industrial associations--in accordance with the sector "industry" (or "agriculture")) This will also contribute to the optimization of the balance of associations with respect to the capacity of the subdivisions--ministries will be forced to eliminate the production enterprises, which are included in them and are not sound economically.

There are many obstacles in the way of the establishment of scientific production associations with a unified economic mechanism. First of all it is necessary that the main institute would be responsible for the development and production of new equipment. Moreover, it is necessary to establish a unified organization with one manager, with one account at the bank, and with common social organizations.

The Kriogenmash Scientific Production Association, for example, operates under such conditions. An integrated system of the management of the efficiency of production, its scientific and technical development, technical preparation, and product quality has been introduced here. This system also includes the automation of the day-to-day management of production and the process of research and development. As a result the time of the development of new machines during the past two five-year plans has been reduced to one-third to two-fifths. New equipment in the production plans comes to 70-80 percent. The assignment of the 11th Five-Year Plan was completed much earlier than the deadline, the national economic saving from the operation of the produced equipment came to 60 million rubles.

At the same time the formation of a unified economic mechanism has not yet been completed at the Kriogenmash Scientific Production Association. The plan is approved for the institute in accordance with the sector "science and scientific service," while for the plant--according to the sector "industry." The work is evaluated in accordance with the volume (gross), and not the qualitative indicators; two systems of the remuneration and stimulation of labor--for the institute and the plant--are in effect.

At present in conformity with the decisions of the 27th CPSU Congress the master plans of management are being revised, while in individual sectors new ones are being drawn up. In this connection science has to be brought closer to production on the basis of the inclusion of sectorial scientific research institutes within production associations and scientific production associations.

The tasks of the scientific research institutes within associations are different. In the scientific production association they solve the problems of the development of the subsector as a whole, in the production association they solve the problems of increasing the technical level of production and the output being produced only of their own association.

The experience of a number of machine building sectors confirms the great effectiveness of the integration of science and production within production associations. For example, the machines and equipment, including drilling rigs, which are being developed by the Scientific Research Institute of Heavy Machine Building of the Uralmash Production Association, are operating in all regions of the country. Several of them are unique--they are intended for the sinking of wells to 15,000 meters, as well as for the development of the continental shelf of seas. In 1985, 14 types of drilling rigs for wells under different conditions and at different depths were produced at the association. With respect to many parameters this equipment is not inferior to the best world analogs, while with respect to several surpasses them. The institute belongs to the association as a component of it, and, therefore, there are no problems with the introduction of the developed innovations, which significantly shortens the "research-production" cycle as compared with autonomously operating scientific research institutes and enterprises.

However, in case of the establishment of a production association it is important to take into account that the capacity of the scientific subdivision should correspond to the needs of the specific works. The exceeding of its optimum size will lead to the need for the conclusion of economic contracts with outside organizations. This, of course, will disperse the scientific potential, will divert it from the accomplishment of the basic tasks, and will decrease the level of specialization.

As was noted above, each scientific production and production association should have a unified economic mechanism. The inclusion in it of scientific institutes under the conditions of full cost accounting eliminates the question of the financing of research and development. In all likelihood, even the assignments, which follow from state and sectorial scientific and technical programs, if their results are used at the association, should be fulfilled at the expense of its own assets. In other cases an economic contract should be used.

The economic stimulation of scientific research institutes and planning and design bureaus, associations, and enterprises, as well as the giving of material incentives to their workers are of great importance for the shortening of the "research-production" cycle. This is a multidimensional problem, therefore, let us dwell only on several aspects of it, which are of the greatest urgency.

First of all the basic directions of the stimulation of the participants in the work on the stages of the "research-production" cycle are meant. It is necessary to pay bonuses for the EARLY AND HIGH-QUALITY fulfillment of the plan assignments on the conducting and implementation of research and development. Here it is important to give incentives for the achievement of a high technical level of production, which on the basis of the calculation of the annual economic impact can be expressed quantitatively. Finally, bonuses should be paid for the expansion of the use in the national economy of the results of research and development.

Many years of experience show that the greatest bottleneck in the advance of the results of research and development to practical use is the stage of

introduction. The basic reason consists in the conflict, on the one hand, of national economic interests and, on the other, of the interests of associations and enterprises. The conflict is manifested in the evaluation of their activity and the mechanism of stimulation; the procedure of the formation of the fund is oriented to a greater degree toward the production of an assimilated, although obsolete product, as well as toward the use of traditional technological processes.

The new conditions of management, the broadening of the rights, and the increase of the responsibility of enterprises did not eliminate this conflict. The fulfillment of the plan of deliveries of products in conformity with contracts is the basic fund-forming indicator of the material incentive fund. It is well known that contracts are not concluded for items which are being newly assimilated. Another fund-forming indicator is the increase of the profit. If there is no possibility of increasing it due to the increased price for the new product, two means of forming stimulation funds remain--the increase of the volumes of the production of assimilated items and the decrease of the production costs.

The first means is extensive, moreover, it is based on the meeting of the needs of the national economy for obsolete products with a low technical level. The second is intensive and is based on the introduction of energy-, material-, and labor-saving technologies. It actually leads to a decrease of social production expenditures. However, if the production of new items is being assimilated at the same time, the decrease within the association (enterprise) can be leveled by the increased expenditures on the changeover of production.

The changeover to the output of new types of products has a substantial influence on all aspects of the economic operations of associations and enterprises. First of all this is the increase of the expenditures per ruble of output, which in many sectors of industry acts as a third fund-forming indicator. The increase occurs due to the effect of the following factors: the increase of the direct labor expenditures of the production of items, their production cost as compared with the items being replaced, defective output during the first period of production, and the production risk.

Moreover, labor productivity--the basic indicator of the formation of the fund for sociocultural measures and housing construction--decreases. The increase of the labor expenditures per 1,000 rubles of output, which is due to the designing and development of new machine tool attachments, the diversion of personnel for the preparation and organization of production, and so on; the decrease of the production volume in physical and value terms, which is due to the lengthening of the production cycle, the increase of the risk, and so on have an influence on this.

The assimilation of a new product requires new equipment, which is inconceivable without its delivery and installation, as well as new materials and components, which leads to the need for additional cooperation, and so on. The set of listed factors is responsible for the decrease of the profit and the decline of the output-capital ratio.

It is important to note the following. The analysis of the nature of the increased expenditures, which are connected with the changeover to the output of new types of products, shows that in most cases they do not depend on associations and enterprises, but are due to the laws of the development of social production and, consequently, are socially necessary. In this connection the mechanism of the management and stimulation of associations and enterprises, which is a tool of centralized management, should envisage their integration. The socialist state has various possibilities for this. It is possible, for example, to take the path of disseminating the experience of the electrical equipment industry, in which the national economic impact of a new product is taken into account when determining the growth rate of the production volumes. In our opinion, the means of improving the economic methods of management, and first of all pricing, is most advisable. Prices should be formed on the basis of the socially necessary expenditures (of course, with allowance made for all the peculiarities and difficulties of their determination). This, first, will lead to the compensation of the increased costs of the period of assimilation of a new product and will contribute to the increase of the interest of producers in speeding up the updating of the production assortment and, second, will become an objective prerequisite of the change of graduated prices.

The assimilation of new equipment and the preparation of production, which is connected with it, are a lengthy period, which includes not only organizational aspects, but also a large amount of design and technological development. The shortening of the "research-production" cycle in many respects depends on their duration and quality. Engineers, whose prestige in recent times has decreased, carry out the design and technological support of the assimilation of innovations. The insufficiently high remuneration of their labor and the lack of a dependence of the amount of the incentive on the end result are the basic causes of the weakening of the role of engineers in the acceleration of scientific and technical progress. During the 12th Five-Year Plan the leading increase of the remuneration of the labor of engineers as compared with other categories of workers is envisaged. By 1990 their wage should increase by not less than 20-25 percent, and in individual cases by up to 30 percent. However, it is planned to accomplish this mainly at the expense of the funds of enterprises, and not the increase of the wage fund.

In Leningrad the experiment on the extension to engineering services of the principles of the Shchekino method and the brigade form of the organization and stimulation of labor has been completed. It was conducted at six very large machine building associations. Its essence is simple--to complete the planned amount of work with a smaller number of performers as compared with the norms, and to use the saved wage fund for their stimulation. During the experiment about 900 designers and process engineers with an annual wage fund of 2 million rubles were released; 75 percent of it was used for incentives. Among those freed there are also those who did not accept the increased amount and pace of work and left at their own request. These are mainly young people, specialists older than middle age remained. But among them as a result of the increased strains fatigue began to tell more often and nervousness increased.

In short, labor productivity increased in terms of the amount of work, which was performed in drawings. However, its increase was not coordinated with the possibilities of production; a portion of the additionally elaborated designs did not find practical application. The redistribution of the fixed wage fund of engineering services and the increase of the amounts of the incentives of a portion of the workers were not coordinated with the production assignment and the end results of the equipment being developed.

The improvement of the experiment and the expansion of the search for new means are necessary for the purpose of enhancing the role of the engineer in the shortening of the "research-production" cycle and the acceleration of scientific and technical progress. One of them is to stimulate engineers on the basis of a two-stage system of stimulation for the end result--the technical level of the equipment being produced and its national economic impact. The work on the development of new equipment in drawings, which has been completed with a high quality and the minimum expenditures of labor and other resources, is stimulated first; the second part of the stimulation is carried out after introduction. It seems possible to pay the second part of the bonus on the basis of the reduction of the annual economic impact to the moment of the payment of the award.

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BETTER USE OF FUND FOR DEVELOPMENT OF SCIENCE, TECHNOLOGY

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[Article by Yu.I. Berliner: "On Means of Increasing the Efficiency of the Use of the Unified Fund for the Development of Science and Technology"]

[Text] The gains, which ensure the new qualitative development of our society, were formulated in the CPSU Program which was adopted by the 27th CPSU Congress. The changeover of the economy of the country to the path of intensification and the large-scale use of the achievements of science and technology is envisaged. A special place in the acceleration of scientific and technical progress in this connection is being assigned to sectorial scientific and technical organizations, for which important tasks on the development of advanced highly efficient equipment and the shortening of the time of its assimilation to one-fourth to one-third have been set.

The Soviet economy has gained considerable experience in the development of optimum methods of the financing of measures on the development and assimilation of new equipment. The unified fund for the development of science and technology (YeFRNT) is playing an important role in the implementation of these measures in the machine building ministries. The existing directive documents clearly specify the directions of its use, particularly for the financing of: scientific research and experimental work on the assurance of scientific and technical progress in the sector; the expenditures on the preparation and assimilation of the production of new and modernized types of products and on the introduction of advanced technological processes; the expenditures on the increase of the quality, reliability, and durability of the products being produced; the increased expenditures in case of the preparation of a new product for production, and others.

The rights of managers of production associations (enterprises) with respect to the use of the assets of the unified fund for the development of science and technology, which have been placed at their disposal, were broadened by the decree of the CPSU Central Committee and the USSR Council of Ministers "On the Extensive Dissemination of New Methods of Management and the Increase of Their Influence on the Acceleration of Scientific and Technical Progress." These assets can be used for the financing of expenditures on the retooling and renovation of enterprises and works and for the implementation of measures on the elimination of bottlenecks in basic and ancillary production, the

expansion of consumer goods production, the increase of product quality, the increase of labor productivity, the decrease of the product cost, and others. All this requires the formulation and implementation of fundamentally new measures on the efficient use of the allocated financial resources.

However, as the check of a number of machine building ministries showed, the measures, which are being implemented by enterprises and sectorial institutes and are financed from the assets of the unified fund for the development of science and technology, do not completely guarantee the increase of labor productivity and the decrease of the product cost. The insufficiently high level of the technological and design preparation of production does not enable them to satisfy to an adequate degree the needs of the national economy for new highly efficient equipment.

The inadequate level of scientific and technical developments and the large amount of work in the thematic plans, which is connected with the drawing up of standard documents and the preparation of reference and information materials, are the basic causes of such a situation. The planned themes do not encompass the entire "research-development-production" process, as a result of which the completed work for long years often does not find practical application.

In speaking about the shortcomings in the use of the unified fund for the development of science and technology, it is impossible not to direct particular attention to two things. First, numerous instances, when the assets of the fund are used for the wrong purpose, still exist. At a number of sectorial institutes technical specifications for special technological equipment, as well as plans of sections and shops and of their retooling are drawn up ostensibly for the speeding up of the performance of work at the expense of assets of the unified fund for the development of science and technology, that is, the assets are used for what should be performed in accordance with direct economic contracts with enterprises. Second, as the analysis of a number of implemented measures shows, the actual indicators of their effectiveness prove to be less than the planned indicators.

In recent years some work on increasing the efficiency of the activity of sectorial scientific research and planning and technological institutes, particularly on streamlining the methods and forms of the financing of scientific and technical operations, has been performed in the Ministry of Heavy and Transport Machine Building. The generalization of the gained experience and the analysis of the existing shortcomings in the use of the unified fund for the development of science and technology make it possible to elaborate recommendations on its more effective use.

If we examine carefully the shortcomings listed above in the performance of the jobs, which are financed from the assets of the unified fund for the development of science and technology, it is easy to be convinced that they are due to one factor: jobs are included in the thematic plans without adequate technical and economic substantiation. As a result considerable manpower and financial resources are often diverted for research, which due to the loss of topicality or the lack of preparation of production subsequently disappears from the plans of scientific research work. In other instances the

jobs were planned in conformity with the assignment for one program of the output of products, but when it came to introduction, they changed it, as a rule, downward as against the planned program. It happens that the need for the use of the developed design (technology, machine) disappears altogether.

Since 1982 the decision of the question on the possibility of including a job in the thematic plan has been made in the Ministry of Heavy and Transport Machine Building after the examination of the initial (technical and economic) demands, which reflect such questions as the urgency of the theme, the probable technical level of the objects of equipment, which are planned for development, the anticipated indicators of efficiency, and the possibility of the duplication of the obtained results at a number of enterprises of the sector. The degree of participation of coperformers (other organizations), the date of fulfillment, the cost of development, and the sources and amounts of bonus payments are reflected here.

Practical experience confirmed the effectiveness of the use of initial (technical and economic) demands when settling the question on the advisability of including a theme in the plan. In case of the examination of the indicated documents in the administrations of the ministry up to 30 percent of the materials submitted by institutes are returned as not satisfying the made demands, a large portion of them undergo correction and subsequent modification. All this made it possible to a significant extent to free institutes from work on minor themes and to focus the basic attention on the accomplishment of highly efficient tasks in the basic directions of their activity.

Obviously, the document, which substantiates the technical and economic advisability of including a theme in the plan, should be given not so much a recommendatory as a directive nature. Although the elaboration without fail of initial demands for themes being newly included in the plan is also envisaged by All-Union State Standard 14.003-74 "The Procedure of the Organization of Scientific and Technical Developments in the Area of the Technological Preparation of Production, Acceptance, and Their Transfer to Production," in practice this did not find proper reflection. The initial (technical and economic) demands should become as if the passport of the theme, which should be presented at all the stages of its passage: in case of the settlement of the question of financing (by dates and amounts), the estimation of the level of bonus payments, financial and accounting audits and checks, and so on.

The work, which is performed with respect to the scientific and technical reserve, is basic, research, and experimental work. Therefore, when in the process of its performance the obtaining of a negative result is evident, it makes sense to halt its further performance. This will make it possible to save financial resources and the time of researchers and to change in good time the direction of the work. The need for its halt or a change of direction should be officially registered by a protocol of the scientific council.

The situation with the work, which is connected with the drawing up of technical specifications and the production and introduction of models of new

equipment, is somewhat different. As the analysis shows, adjustments of the plan through the fault of institutes is a very rare thing. Their basis causes are: the violation of the deadline of the placement into operation of objects of capital construction, renovation, or retooling, at which the use of the results of scientific and technical developments was planned; the lack of capacities for the production of special technological equipment; the ill-timed ordering and receipt of standard equipment, accessories, tools, and materials; the lack of space for the accommodation of developed lines, sections, and so on.

Of course, the plan can be changed and adjusted by the instance which approved it. In recent years a procedure, which stipulates that the thematic plans of sectorial institutes are approved by administrations, which are superior with respect to them, or by the deputy minister for new equipment, has been established in the machine building ministries. This step contributed to the increase of the effectiveness of the plans being drafted, to the concentration of the efforts of institutes on the accomplishment of priority tasks, as well as to the coordination of the thematic plan with the plans of material and technical supply, capital construction, and retooling. The making of the decision on the necessity of adjustments makes it possible to consider in a more qualified manner what the situation is with the introduction of specific objects of new equipment and what it is necessary to do for the fulfillment of the assignment on time. The indicated step as applied to themes, which are carried out in accordance with economic contracts with enterprises, is more effective than decisions which are made at the institute-enterprise level, that is, at the level of organizations which are often not authorized to settle questions which are the competence of the ministry.

The procedure of making changes in the thematic plans, which has been established in the Ministry of Heavy and Transport Machine Building, envisages the preliminary consideration of the causes of the nonfulfillment of assignments with the appropriate administrations, to which the enterprises are subordinate, and the approval of the list.of changes by the management of production associations, scientific production associations, or administrations of the ministry, to which the institutes are subordinate. For the reduction of the paper flow, the elimination of unnecessary correspondence, and the broadening of the rights of the executives of institutes they have been granted the right to approve changes to the thematic plan in case of: the introduction of new themes with an estimated cost of not more than 10,000 rubles; the increase of the estimated cost of themes by not more than 10 percent; the shortening of the time of the fulfillment of themes or the decrease of their estimated cost without a change of the planned results of the work; the change of the deadlines of the fulfillment and the estimated cost of stages without a change of the deadlines of the completion of the theme and the results of the work as a whole, as well as the deadlines or volumes with respect to themes which are being fulfilled for enterprises and organizations of other ministries and departments (in consultation with them). Along with the elaboration and implementation of measures on the increase of the efficiency of the use of the unified fund for the development of science and technology the streamlining of the enforceable enactments, which regulate questions of the planning and use of the assets of this fund at sectorial institutes, should, in our opinion, be continued.

In connection with the complication of the tasks on the management of scientific and technical progress at sectorial institutes divisions, which perform work on the long-range development of the subsector or the sector as a whole, are operating. This is the drafting of current and long-range plans of new equipment and standards of the use of material and energy resources, the making of an analysis of the existing capacities of production and the elaboration of measures on the improvement of its specialization, and others. The elaboration of sectorial standard technical materials and manuals of technical and economic indicators of the operation of enterprises, the preparation of surveys on the present state of the directions of work, which are attached to the institute according to its specialization, and others are an indispensable part of the activity of sectorial technological institutes. The amount of such work comes to 20-25 percent of the total amount of work of the institute.

However, as the analysis attests, the obtained results from the performance of the work listed above at times do not satisfy the demands being made. In particular, plant instructions, which for their most part have been copied from state standards, are developed instead of the formulation of sectorwide standards. The need for the annual performance of work of an analytical and information nature is not always substantiated. It is sufficient to perform the majority of it twice during a five-year plan: at its beginning and end. The materials of the Central Statistical Administration are not being used extensively enough, as a result of which specialists of the institutes study at enterprises a significant quantity of data which is available in statistical reporting. In our opinion, which is based on the analysis of the activity of a number of sectorial institutes, the amount of such work should not exceed 15-16 percent of the total amount of work of the institute. First of all the institutes should specialize in the performance of specific operations. It is necessary to concentrate specialists as much as possible under common scientific and administrative management and to free institutes from work which is a direct function of enterprises.

The unified fund for the development of science and technology is the source of financing of work on the planning of the development of the sector (of an analytical and information nature). This fund might be the only source of financing of work of this sort, which is being performed for the corresponding subsector or the sector as a whole, while the corresponding structural subdivisions of the ministry act as its client.

It is stipulated by directive instructions that the work on the scientific and technical reserve is financed in the amount of up to 20 percent of the assets of the unified fund for the development of science and technology, which are allocated for the performance of scientific research, experimental design, technological, and experiment work on the assurance of scientific and technical progress in the sector. But this standard does not reflect the real ratio of engineering and ergonomic work at the institute and does not promote the development of promising directions. The following ratio has now formed in the sources of financing of the mentioned work: 60-70 percent due to economic contracts, the remainder at the expense of assets of the unified fund for the development of science and technology. As was indicated above, 20-25

percent is work, which is connected with the formulation of the prospects of the development of the sector, work of a reference and information nature, and others. At present the work, which is connected with the elaboration of standard solutions with respect to automated technological complexes, flexible machine systems, computer-aided design of equipment and technology, plant automated management systems, and so on, makes up a large amount at institutes. It is also carried out at the expense of the unified fund for the development of science and technology. Thus, not more than 2-3 percent of the assets are left directly to the scientific and technical reserve in the directions of work, which are attached to the institute.

It seems advisable to allocate assets of the unified fund for the development of science and technology on the basis of the amount of work in the basic directions of the activity of the institute. This means that the expenditures on work connected with the formulation of the prospects of the development of the sector, standardization, and others, with respect to which the performance of research themes and applied research is not envisaged at sectorial institutes, are excluded from the total amount of work performed by the institute. Such an approach makes it possible to evaluate more objectively the factors which determine the proportions in the financing of work on the scientific and technical reserve and technical development.

Since at the institute not all the divisions are the main ones in the sector for the technological process stages and directions of work, which are attached to the institute, the proportions in the sources of financing of the work on the scientific reserve and development will also be different. The level of these proportions will depend on a number of factors: the number and structure of the scientific and technical subdivisions; the availability of personnel of the highest skills; the supply of the laboratory and experimental base; the achieved technical level of production and the prospect of its increase, and others. Due to the diversity of the factors, which influence the establishment of the optimum proportions, it is difficult to advance scientifically sound recommendations. However, on the basis of practical experience it is possible to assert that the amount of work on the scientific and technical reserve should account for not less than 20 percent of the total expenditures on the performance of scientific thematic themes.

The fundamental improvement of the financial relations in sectorial science is possible only on the basis of the radical change of the principles of the economic operations of these organizations. The improvement of their activity on the basis of the extension of cost accounting, in our opinion, is such a main lever. Since the early 1970's work on the improvement of cost accounting has been performed at scientific and technical organizations. This found reflection first of all in: the changeover to the planning of the activity of organizations on the basis of supply orders, which are opened for all types of work, which are envisaged by the sectorial plans, and have the force of economic contracts; the change of the procedure of settlements for the performed work, which consists in payment for work, which has been completely finished and has been accepted by the client; the changeover to a system of material incentives, which depend on the amount of the economic impact which is obtained as a result of the introduction of developments in production, and so on.

The further consolidation of cost accounting should proceed in the direction of the singling out of the category of the profit for sectorial scientific and technical organizations as one of the basis indicators of the evaluation of their activity along with the indicators of the efficiency of work. The availability of a standard base for the standardization of the work being performed is an important condition of the introduction of this indicator in practice. In the thematic plan of sectorial scientific and technical organizations the work on the scientific and technical reserve and the performance of pilot and experimental operations makes up approximately 20 percent of the amount of work being performed, the work connected with the planning of the prospects of the development of the attached sector (subsector)--20 percent, and design and technological development which is performed in accordance with contracts with enterprises--60 percent.

The first two types of work are financed from the unified fund for the development of science and technology. Being performed on the scientific and technical reserve, especially the pilot and experimental work, they have a large share of uncertainty in the obtaining of an end result and in practice do not lend themselves to standardization. The work connected with the planning of the prospects of the development of the sector (subsector), as a rule, is performed annually in accordance with the assignment of superior organizations. On the one hand, its standardization might also not present significant difficulties, but, on the other, this work in connection with its financing from the unified fund for the development of science and technology cannot be a source of the formation of the profit.

The third type of work, which is connected with the performance of design and technological development and with the designing and production of special technological equipment, is liable to standardization. Sufficient experience in the generation of standard documents on this question has been gained in industry. Thus, in recent years limit price handbooks for the production of nonstandardized and special technological equipment, of which structurally similar groups of this equipment have been made the basis, have been introduced on the basis of standards of planning and design work. The indicated work can also be a source of the profit.

The net profit, which is derived by the institute, should become the only source of the retooling of its laboratory base and pilot production and the social development of the collective. In other words, it will earn itself the assets for capital investments. And the more efficient developments are and the more rapidly they find practical application, the more assets the institute will be able to invest in its technical and social development. The success of the development and introduction of a new system of cost accounting relations to a great degree will depend on the organization of this work, in which in addition to financial and accounting personnel the specialists of the technical and planning services should participate.

The consolidation of cost account makes it possible to a greater degree to focus the attention of specialists of sectorial institutes on the accomplishment of the vital tasks at the enterprises attached to them (the introduction of new equipment and technology which provide a saving of

manpower and material resources and so on) and to finance their activity by means of economic contracts with these enterprises. The allocation to the institute of assets from the unified fund for the development of science and technology makes it possible to develop new means of improving scientific and technical progress.

The accomplishment of both tasks requires the regulation and the elaboration of the corresponding standards of the amounts of the unified fund for the development of science and technology, which are allocated to the institute. Depending on the type of institute (scientific research, planning), the themes being elaborated (design, technological), subordination (sectorial, subsectorial, within a scientific production association or production association), the level of specialization of the work, and so on, the standard of the assets of the unified fund for the development of science and technology, obviously, will be different. The analysis of about 50 types of sectorial institutes shows that at present the following amounts of assets of the fund, which are allocated to them, has formed (as a percent of the total amount of work): scientific research design--50-61 percent; planning and design--32-42 percent; scientific research technological--46-60 percent; institutes within production associations--27-34 percent.

The development of standards of the assets, which are allocated from the unified fund for the development of science and technology, will probably require the more thorough analysis of all aspects of the activity of the institutes. The efficient use of the mentioned fund at sectorial institutes is not only the assurance of a saving on the expenditures of financial resources. First of all this is the choice of urgent directions of the development of science and technology and in the end the increase of the efficiency of social production. This is the further consolidation of cost accounting at sectorial institutes and, as a consequence, of the contact of science with production. The implementation of the set of examined measures, which are aimed at the increase of the effectiveness of the use of the unified fund for the development of science and technology, requires the drawing up at the state level of standard documents, in which the positive experience gained in the sectors should be generalized.

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COST ACCOUNTING METHODS OF STIMULATING SECTORIAL SCIENCE

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[Article by Doctor of Economic Sciences M.I. Mamuzon, head of a laboratory of the All-Union Scientific Research Institute of Electrical Machine Building, and I.D. Moskovskiy, chief of the Financial Administration of the Ministry of the Electrical Equipment Industry, under the rubric "Finance and Scientific and Technical Progress": "Cost Accounting Methods of the Intensification of the Activity of Sectorial Scientific Research Institutes and Design Bureaus"]

[Text] The acceleration of scientific and technical progress, as was noted at the 27th CPSU Congress, is the most important lever of the intensification of the national economy. A large role in the increase of the efficiency of science should be played by its sectorial sphere, which directly supports the integration of science with production. The changeover of sectorial scientific and technical organizations (ONTO's) to intensive methods of work involves the extensive use of economic levers and stimuli and the introduction of cost accounting. Some experience in accomplishing these tasks has been gained in the electrical equipment industry.

As was noted in the Policy Report of the CPSU Central Committee to the 27th congress: "Some experience in the improvement of the economic mechanism in the sphere of science and its interaction with production has already been gained in our country. It is necessary to analyze it carefully and, without delaying, to introduce it...."

It is possible to divide the economic experiment on the improvement of the management of scientific and technical progress in the electrical equipment industry into two stages. The first began in 1969 and encompassed: planning (the comprehensive planning of developments on the basis of supply orders was introduced), financing (the unified fund for the development of science and technology was established), economic stimulation (it was made dependent on the deductions from actually introduced developments), the management of the process of increasing product quality (certification by quality categories was introduced).

The second stage began in 1978. Particular attention was devoted to the use of economic levers for the quickest completion of jobs and their delivery to clients. Three measures were most significant: the changeover to the system

of settlements for completely finished jobs; the introduction of the directive planning of the amount of work, which was completely finished and delivered to clients; the giving to sectorial scientific and technical organizations of their own working capital for the covering of the expenditures in the unfinished performance of work which is financed from the unified fund for the development of science and technology.

The changeover of sectorial scientific and technical organizations to settlements for work, which has been completely finished and accepted by the client, is aimed at the intensification of research and development. This is an important step in the direction of the development of cost accounting in sectorial science.

Stage-by-stage settlements have become obsolete. They are not aimed at the end results of the work and create the economic conditions for the lengthening of the cycle of development. Neither the degree of completion of the work nor the total time of its fulfillment influences the financial status of the developer. The aspiration and opportunities appear to overstate the cost of the initial stages and to decrease the cost of the more labor-intensive final stages so that the delay in the completion of the work would not affect the financial status of the organization. At the 16 studied institutes the excess of the amounts received from clients in payment for unfinished work over the actual expenditures came to 13.6 percent of the annual amount of research and development. In instances, when in case of completion of the work the revision of the estimated cost on the basis of the actual expenditures is envisaged, the developer is interested in delaying the completion of the work, in order to postpone the return of the excessively received assets in accordance with the intermediate certificates. Stage-by-stage settlements facilitate the possibility of the migration of assets from the budget accounts of the clients to the current accounts of the developers (on the basis of certificates which reflect the percentage of completion), especially at the end of the year--for the purpose of the most complete "assimilation" of the allocated appropriations. The assets are diverted to the accounts receivable, which are disguised in the form of "payment for work in accordance with partial readiness." As a result significant resources, which do not yield a real return, are immobilized.

All this has the result that the established practice of settlements for completed research and development, just as the entire system of the financing of sectorial science, is not conducive to the quickest completion of development. One of the consequences is the continuous leading increase of unfinished work. For example, at organizations of the Ministry of the Electrical Equipment Industry the average annual growth rate of unfinished work led the growth rate of the amounts of research and development, which are conducted at the expense of assets of the unified fund for the development of science and technology, during the 9th Five-Year Plan by 4.6 percent and in 1976-1977 by 13.6 percent. Only after the implementation of a number of measures at the second stage of the experiment was it possible to halt this process (during 1978-1984 the lead came to 0.1 percent).

The changeover to settlements for completely finished work is impossible without serious preparation. It is necessary to solve a number of problems, of which the following ones are the most important.

It is necessary to specify the objects and dates of payment under the conditions of settlements for completed work. Here it is important to avoid two extremes--the reduction of themes to individual (although even important) stages and the hypertrophy of themes and their identification with the scientific and technical program. The decisive attribute of the theme being paid for is what is introduced in production: an individual machine, an automatic line, a technological process, a subsystem of an automated control system, a standard, or a scientific development for the creation of a reserve for the future. When settling the question of when to make payment--upon completion of a development or after its introduction--it is necessary to be guided by the principles of cost accounting. The cost accounting scientific organization should receive payment for its final product--the completed development which has been delivered in accordance with established procedure to the client. Introduction should be supported by the corresponding system of management of scientific developments, which is stimulated economically and is monitored by means of systems accounting (accounting). The organization of such accounting at the developers, clients, and enterprises, which introduce developments, was proposed. The USSR Ministry of Finance and the USSR Central Statistical Administration have established the procedure of accounting, although its practical introduction is being carried out slowly and incompletely.

In general the objects and dates of payment are specified in the Instructions on the Changeover of Sectorial Scientific Research, Planning and Design, Technological, and Planning and Surveying Organizations to the System of Payment for Work Which Has Been Completely Finished and Accepted by the Client. The corresponding all-union state standard, in which several sectorial peculiarities should also be taken into account, should be drawn up and approved for the more complete and precise regulation of the objects and dates of payment.

In connection with the changeover to settlements for completed work the introduction of the planning of the amount of work, which has been completely finished, delivered to the clients, and paid for by them (more precisely, the sales volume of the scientific product), is an important measure. In the electrical equipment industry this new directive indicator was introduced in 1978 and was included in the material incentive system. The fulfillment of the plan of the sale of the scientific product is a mandatory condition of the payment of bonuses to management personnel of scientific research institutes and design bureaus in accordance with the results for the corresponding quarter.

The form of the annual plan, the method of drafting it, and the means of coordinating it with the plan of financial have been elaborated. The experience of the organizations, which were changed over in 1978 to the system of settlements for completely finished work on the basis of their provision with internal working capital, showed that the annual estimates of the volume of delivery of work, which were drawn up by them and are oriented toward the

former conditions of financing, contained reserves in the amount of 18-24 percent of the annual amount of research and development. The identification and especially the mobilization of these reserves in the interests of accelerating development are not a simple process. It requires the item-by-item study of each theme and each supply order. But the merit of the new system of settlements and the strength of the economic levers, which under former conditions did practically nothing, consist in this.

The influence of this indicator on the activity of sectorial scientific and technical organizations increases substantially, if the planning of the sales volume of the scientific product is combined with the improvement of the other elements of the cost accounting mechanism--the material incentive system, settlements for completed work, and the provision of organizations with internal working capital.

The combination of directive planning with the use of the cost accounting mechanism makes it possible to accomplish the entire set of tasks. Organizations aim at the completion of developments on the planned or an earlier date, since the end results are linked with the amount of financing and the continuous supply of monetary resources. The new economic conditions prevent the dragging out of the work and the aspiration to extend the planned deadline, since for the preservation of the necessary amount of financing it is necessary to offset the declining amounts of work with other work which is equivalent in value. Moreover, tools of the planned management of the process of forming unfinished work and the tightening up of the monitoring of its completion are created. Prior to this the value of the unfinished work was not planned, its dynamics and the amount of immobilized resources formed spontaneously.

It is impossible to accomplish the changeover to settlements for completely finished work without the provision of organizations with the monetary resources necessary for the entire planned cycle from the start to finish of development. The assurance of the coverage of the expenditures of developing organizations for the period to the planned date of delivery of the work is the most difficult problem of the changeover to the new system of settlements. It can be effectively solved on the basis of the efficient combination of internal (intrasectorial) and borrowed resources (credits of the State Bank). The internal working capital, which is necessary for meeting the standard need for production stocks and expenditures on the incomplete performance of work, which is financed from the unified fund for the development of science and technology, should be formed at the expense of intrasectorial resources. The expenditures in the incomplete performance of work, which is performed in accordance with contracts with clients who do not belong to the system of the given ministry (department), as well as for other temporary needs, which stem from the nature of the investment cycle in sectorial science, should be covered by credits of the State Bank.

The provision of internal working capital for the covering of the standard of the incomplete performance of work, which is financed from the unified fund for the development of science and technology, should be carried out without the increase of the amount of financing of sectorial scientific and technical associations and the change of the amount of research and development during

the initial year. The possibility of such a solution stems from three factors. The first is connected with the peculiar structure of the standardized working capital of sectorial scientific and technical organizations, which consists of two unequal parts. Production stocks (their planned amount is provided by internal capital and the capital equated with it) constitute one (4-6 percent), while the incomplete performance of research and development forms the second (94-96 percent). Under existing conditions this part in case of any sources of financing (budgetary, centralized, economic contractual) should be covered by means of resources of the clients. Such resources are temporary working capital, which is received by sectorial scientific and technical organizations in the form of advances and payment for partially completed work (stages) on unfinished themes. The concept of "temporary" working capital in this case is of a conditional nature, since sectorial scientific and technical organizations in practice do not return it, but repay it ("work it off").

The second factor presumes the availability of a unified centralized source, by means of which the ministry (general client) carries out the financing of research and development. This makes it possible in necessary cases to change channels (the payment for completed work, the replenishment or withdrawal of working capital), channeling the capital in those of them, which ensure the functioning of the adopted system of financing. The third factor is characterized by the fact that in the initial, just as in any other year the scientific organization requires assets for research and development in the amount of the sum of expenditures on their performance. Under the conditions, when a profit is not planned for the organizations, this sum is equal to the annual amount of research and development in the estimated valuation (a slight difference between the estimated value of the annual volume and the real amount can occur in instances of the change of the amount of the stable liabilities at the beginning and end of the year).

The interaction of the listed factors makes it possible to accomplish the provision of sectorial scientific and technical organizations with internal working capital for the covering of the expenditures in the incomplete performance of work, which is carried out at the expense of the unified fund for the development of science and technology (in the electrical equipment industry it comes to about 65 percent of the total amount of research and development), within the limits of the resources which are allocated in accordance with the plan of the financing of research and development for the initial year. A peculiarity of this method consists in the fact that the provision of internal working capital is carried out not by way of the new advancing of resources to cost accounting organizations, but by the redistribution (use) of the capital previously transferred to them. This makes it possible not to attract additional assets from the accumulation fund owing to the mobilization (redistribution) of internal resources. The implementation of such a method requires the making of the following decisions.

The balance of the financing from the unified fund for the development of science and technology for the payment for the completed stages with respect to the unfinished work, as well as the advances from this fund, which have not be repaid, should (within the limits of the standard need) be included in the

authorized capital stock of the organization as a source of internal working capital. Thereby "others'" (temporary) capital turns into "internal" capital, which is permanently attached to the organization.

In connection with the transfer of the balance of financing from the unified fund for the development of science and technology the entire incomplete performance of research and development remains unpaid. Therefore, subsequently in case of the delivery of the complete work (themes) it is subject to payment in the full amount without the retention of the sums previously received for the intermediate stages. This in principle makes it possible to provide with internal working capital the scientific and technical organizations of industry and construction without the attraction for the indicated purpose of additional operating resources. Thus the advancing of new resources for the formation of the internal capital of organizations is replaced by the transformation of the previously allocated resources; the opportunity appears to meet the current need of sectorial scientific and technical organizations for monetary assets on the basis of the use of the cost accounting principle of their circulation, and not expenditure; the full payment for completed themes stimulates their quickest completion. As to the "repeated" payment, it is illusory, since the total annual amount of financing, as is shown in Table 1, is limited to the annual amount of expenditures, which in case of any system needs complete covering.

From the table it follows that the entire actual balance (which in this case in equal to the standard) of unfinished production at the beginning of the year (100,000 rubles) was financed at the expense of the assets of the unified fund for the development of science and technology. The amount of research and development for the planned year is envisaged as 150,000 rubles. In case of the old system these expenditures would be covered at the expense of the unified fund for the development of science and technology by the issuing of advances and the payment for work according to the degree of readiness.

According to the new system the organization will receive the same 150,000 rubles, but here the procedure (channels) of receipt of the assets changes in principle: it is strictly linked with the amount and the date of delivery of the completely finished work and with the planned changes of unfinished research and development, that is, it is incorporated fundamentally in the cost accounting mechanism of financing.

In 1978 and 1984, 60 percent (in 1985 another 23 percent) of the scientific and technical organizations of the Ministry of the Electrical Equipment Industry were provided with internal working capital in accordance with the total standard need, excluding the expenditures on work which was being performed in accordance with contracts with clients. Here additional assets of the unified fund for the development of science and technology, in excess of those planned for the financing of the amount of research and development of the initial year, were not required.

Owing to the taken steps positive results were achieved. The rate of the delivery of completely finished work, which is financed at the expense of assets of the unified fund for the development of science and technology (the ratio of its amount to the amount of research and development for the

corresponding period), during 1978-1984 increased as against 1971-1977 for the sector by 29.3 percent, while at the organizations, which were provided with internal working capital and were converted to settlements for completely finished work, (Footnote 1) (Hereinafter called "the organizations of the experimental group") it increased by 43.3 percent.

Table 1

Modification of the Forms of Financing of Research and Development Under the Conditions of the Provision of Scientific and Organizations With Internal Working Capital
(figures are conditional, thousands of rubles)

Amounts of research and development		Forms of financing	
Balance of incomplete performance (NZP) of research and development at beginning of planned year	100	Financing at expense of assets of unified fund for the development of science and technology	100
Amount of work of planned year	150	Amount of financing of planned year according to the old system (for issuing of advances and paying for work according to the degree of readiness)	150

According to the New System of Financing

First Version

Amount of implementation of research and development	150	Payment for completely finished (delivered) work	150
Change of balance of unfinished production	-	Change of working capital	-
Balance of unfinished production at end of year	100	Total amount of financing	150

Second Version

Amount of implementation of research and development	100	Payment for completely finished work	100
Change of balance of unfinished production	+50	Replenishment of working capital for increase of standard of unfinished production	50
Balance of unfinished production at end of year (with corresponding change of standard of working capital)	150	Total amount of financing	150

[Table continued on following page]

Amounts of research and development | Forms of financing

Third Version

Amount of implementation of research and development	175	Payment for completely finished work	175
Change of balance of unfinished production	-25	Including due to freeing of assets in connection with decrease of standard for unfinished production (from 100 to 75)	25
Balance of unfinished production at end of year (with corresponding change of standard of working capital)	75	Total amount of financing	150

The level of unfinished work, which is financed at the expense of assets of the unified fund for the development of science and technology (the value of unfinished production as a percentage of the annual amount of performed research and development), had decreased on 1 January 1985 as against the initial year of 1979 for the sector by 8.9 percent, while at organizations of the experimental group it had decreased by 57 percent. In this group the balances of unfinished work, which is financed at the expense of the unified fund for the development of science and technology, during the period of activity under the conditions of the cost accounting system of the financing of work increased by 4.3 percent with an increase of the amount of research and development by 11.1 percent.

At the organizations of the experimental group in 1984 higher results with respect to a number of other indicators were also achieved (see Table 2).

The financial base for the development of cost accounting was created at the scientific organizations which were provided with internal working capital. The structure of the working capital changed. Its standardized portion increased from 6 to 86 percent. The proportion of internal working capital increased from 4 to 59 percent. The financial status of the scientific organizations was strengthened. The standardization of working capital makes it possible to organize its planned management on the basis of the approved standards.

Prior to the appearance of Decree No 695 of the CPSU Central Committee and the USSR Council of Ministers of 12 July 1979 the conditions did not exist for the changeover to settlements for completely finished work, which is performed by sectorial scientific and technical organizations in accordance with contracts with clients which do not belong to the system of the given ministry (department). It is difficult to use here the system of the provision of internal working capital, which has been adopted for intrasectorial work, since there are no common source, no common client, and no possibility to ensure conformity between the amount of expenditures on research and development and the sum of the receipts from the sale of the completed work in the annually approved balance sheet of revenues and expenditures (the financial plan) of the developing organization.

Table 2

Some Indicators of the Effectiveness of the Cost Accounting System of the Financing of Research and Development for 1984

Indicator	Total amount of research and development			Work financed at expense of assets of unified fund for development of science and technology		
	sector	organization of experimental group	difference, percent	sector	organization of experimental group	difference, percent
Rate of delivery of completed work, percent of amount of performed research and development	89.6	102.2	+12.6	87.2	103.4	+16.2
Change (±) of average time of development as compared with 1983, percent	+10.7	-4.4	-15.1	+2.8	-5.7	-8.5
days	+120	-55	-175	+32	-74	-106
Change (±) of capital-output ratio of research and development (amount of working capital per ruble of research and development), percent	+2.2	-7.1	-9.3	+3.3	-4.5	-7.8
Saving (-), additional attraction (+) of working capital as compared with 1983 level, millions of rubles	+24.3	-15.3	-	+18.0	-3.2	-
Increase (+) of economic impact from introduction of research and development, percent	+7.0	+20.6	+13.6			
Increase (+) of economic efficiency per ruble of expenditures on performance of work, percent	+3.1	+16.1	+13.0			

[Table continued on following page]

Table 2 (continued)

	Total amount of research and development			Work financed at expense of assets of unified fund for development of science and technology		
	sector	organization of experimental group	difference, percent	sector	organization of experimental group	difference, percent
Increase (+) of economic efficiency per ruble of made expenditures, percent	+2.5	+17.3	+14.8			
Increase (+) of economic impact per worker of basic activity, percent	+6.4	+15.3	+8.9			
Increase (+) of economic impact per ruble of standardized working capital, percent	+1.3	+24.1	+22.8			
Change (±) of economic impact per ruble of fixed capital, percent	-0.4	+13.1	+13.5			

However, the procedure of extending credit to sectorial scientific and technical associations, which is stipulated in the letter of the USSR State Bank of 27 October 1982, in our opinion, contains a number of shortcomings. The acceleration of research and development and their quickest delivery to clients are not stimulated (if the work is completed ahead of time, the period of the extension of credit will be shortened accordingly). The amount of credit depends on the amount of expenditures of the organization, and not the amount of completed work. Obstacles to adjustments of the deadlines of the completion of work are not created, since their extension entails only the payment of increased interest, which does not involve for the developer appreciable economic consequences. The role of the current account is devalued to a significant extent, since it is reduced to the accounting of transit operations. There is no monitoring of the progress of the work in the process of extending credit for it. The establishment of norms and standards for the most important components of the working capital is not envisaged, consequently, the monitoring of the conformity of the actual balances to the economically sound balances is impossible, the acceleration of the turnover rate of capital is not stimulated. The practice of credit operations is significantly complicated, the expenditures on the performance of research and development increase appreciably (by the amounts of the fee for credit). The cost accounting principle of equivalence is violated: interest is collected for the use of credit, while the State Bank uses free of charge the accumulated resources, by means of which the credit is issued.

The noted shortcomings can be eliminated or substantially reduced, if the covering of the expenditures of developers in unfinished work is carried out on the basis of the combination of internal and borrowed resources. With allowance made for this direction of expenditures the sources of coverage should also be modified in the following manner (Table 3).

Along with the introduction of the system of settlements for completely finished work and the creation of the financial base for the cost accounting activity of sectorial scientific and technical organizations the further development of cost accounting involves the inclusion of the profit in the sphere of the cost accounting of large organizations, the conversion of the process of the reproduction of fixed capital to a cost accounting basis, the elaboration of a set of cost accounting value indicators, and the development of internal (intra-institute) cost accounting. Let us examine several of these directions.

The profit of scientific and technical organizations is one of the little studied categories. It is directly connected with the pricing of research and development. Several economists deny altogether the category of the price of the scientific product, others suggest various models of its formation.

It is possible to agree with the opinion that "the establishment of prices for such an object as research and development should be carried out on the basis of the maximum use of the general methodological principles of pricing under the conditions of socialism and with allowance made for the specific nature of this product." (Footnote 2) (V.A. Pokrovskiy, "Povysheniye effektivnosti nauchnykh issledovaniy i razrabotok" [The Increase of the Efficiency of Scientific Research and Development], Moscow, Ekonomika, 1978, p 178)

Table 3

Modification of Sources of Assets in Case of the Changeover to the Cost Accounting System of the Financing of Sectorial Scientific and Technical Organization on the Basis of Their Provision With Internal Working Capital

Directions of expenditures	Sources of covering of expenditures	
	given existing system of financing	under conditions of new system of financing
1. Expenditures in incomplete performance of work on date of provision of internal working capital	1.1. Balance of financing of research and development at expense of assets of unified fund for development of science and technology	1.1. Authorized capital stock (within the approved standard of incomplete performance of research and development, which is carried out at expense of assets of unified fund for development of science and technology
	1.2. Indebtedness to main organizations of own ministry on advances and settlements for intermediate stages of work which is performed at expense of assets of unified fund for development of science and technology	1.2. Authorized capital stock (within the approved standard of incomplete performance of research and development in this direction of work)
	1.3. Indebtedness to clients on advances and settlements for intermediate stages of work, which is performed in accordance with contracts	1.3. Stable liabilities (for the period until repayment of indebtedness and changeover to covering of such expenditures by credits of State Bank)
2. Expenditures on performance of work of year being planned (current expenses of organization	2.1. Advances at expense of assets of unified fund for development of science and technology	2.1. Assets for payment for completely finished work which is financed at expense of assets of unified fund for development of science and technology

[Table continued on following page]

Table 3 (continued)

Directions of expenditures	Sources of covering of expenditures	
	given existing system of financing	under conditions of new system of financing
	2.2. Assets for payment for intermediate stages of work which is financed at expense of assets of unified fund for development of science and technology	2.2. Assets for covering of difference (shortage) between amount of expenditurns (paragraph 2) and receipts from sale of products of year being planned (paragraph 2.1): in case of a temporary (up to 2 years) shortage--by way of covering of shortage of assets on terms of return (by redistribution of surpluses of financing or resources of unified fund for development of science and technology); in case of stable (2 years and more) shortage of financing--by supplementing working capital by sum of increase of standard (at expense of assets of unified fund for development of science and technology, which are freed in connection with changeover to settlements for completely finished work)
	2.3. Advances on contracts with clients	2.3. Assets received for completely finished work performed in accordance with contracts with clients
	2.4. Assets of clients for payment for intermediate stages of work	2.4. Credits of State Bank for covering expenditures in unfinished work being performed in accordance with contracts with clients (within the limit of assets freed at clients')

The individual nature of developments and their uniqueness dictate the condition that the normal individual expenditures of the organization on the performance of work are also in this case socially necessary (there are no others, but society needs this development). Social needs determine the boundaries "of those portions of the social working time which it is possible to spend efficiently on various special spheres of production...." (Footnote 3) (K. Marx and F. Engels, "Soch." [Works], 2d edition, Vol 25, Part II, p 186).

The question, consequently, reduces to what to regard as the normal expenditures, which should be taken as the basis of the price, and how to determine them. It seems that the expenditures, which are necessary for the performance of research and development under the given conditions and in the set time in accordance with the program, which has been coordinated between the performer and the client, are normal. Excessive, and especially unproductive outlays, of course, cannot be regarded as necessary expenditures.

Price lists for typical (recurrent) components of the work should be elaborated and approved for the introduction of sound prices for research and development. According to several estimates these components account for 70 to 90 percent of all the expenditures which can be encompassed by standardization. For original components it is necessary to compile estimated costings, which should then be checked on the basis of reporting data. Before the solution of the basic problems of pricing in sectorial science the prices for research and development should be based on the necessary individual expenditures. Their amount should be determined on the basis of the estimated costings which have been coordinated between the developer and the client. The client, or on his instructions experts, should have the opportunity to check the correctness of the attribution of the expenditures on the corresponding development. Unproductive outlays (increased interest for credit, fines), as well as the expenditures, which are not connected with the fulfillment of the given job, should not be reimbursed by the client.

In most cases it is impossible to determine completely the soundness of the estimated costings at the stage of compilation. Therefore, it is advisable to retain the procedure of revising the estimated cost of the work on the basis of accounting data, which was introduced by the instructions of the USSR State Committee for Science and Technology, the USSR State Planning Committee, the USSR State Committee for Construction Affairs, the USSR State Committee for Labor and Social Problems, and the USSR Ministry of Finance of 12 October 1979. Here the accounting price (the revised estimated cost) should not exceed the actually substantiated expenditures by more than 3 percent. The 3-percent excess of the accounting price over the actual cost of the work (within the limits of the approved estimated cost) forms the basic profit, which is not used as a source of the creation of the material incentive fund. The latter is formed by means of deductions from the actual economic impact, which are received from the enterprises (associations) which introduced the developments.

However, such a situation decreases the interest of the developing enterprise in the profit and devalues its cost accounting role. Therefore, it is important to create conditions, under which the sectorial scientific and

technical organization will be interested in obtaining a profit, which is channeled into its cost accounting funds, first of all the material incentive fund. It seems that such a profit should be linked with the early completion of the work and the saving of the wage of the developers, which stems from this. In this way, as well as by means of other measures the organization can achieve a real decrease of expenditures, which lends itself to verification and due to which an additional profit is formed. The scientific organization should have the opportunity to obtain from the client this additional profit (in excess of the 3 percent) and use it for increasing the cost accounting stimulation funds.

Under these conditions the model of the accounting price ($Ц_р$) for the completed research and development and the formation of the profit will assume the following form.

The planned price for the theme (rubles) is $Ц_п=С_п$, where $С_п$ is the planned expenditures on the performance of the work (theme).

The accounting price (rubles), in accordance with which the client pays for the completed development, is $Ц_р=С_ф+П_о+П_д$, where $С_ф$ is the actual expenditures on the completely finished work (theme), $П_о$ is the basic profit in the amount of 0.03 X $С_ф$ on the condition that $С_ф+П_о \leq Ц_п$. If $С_ф+П_о > Ц_п$, then $П_о=Ц_п-С_ф$. If $С_ф > Ц_п$, then $П_о$ is not credited, while $Ц_р=Ц_п$.

$Р_д$ is the additional profit, which is equal to the saving of wages as compared with the estimated amount ($Э_{сз}$) with respect to work completed ahead of time, if $Э_{сз} \leq 0.66Э_о$, (Footnote 4) (It corresponds to the proportion of wages (57 percent) and the deductions for social insurance (9 percent) in the total amount of the expenditures on research and development, which are performed on their own, at the sectorial scientific and technical organizations of the electrical equipment industry) where $Э_о$ is the residual saving of the estimated expenditures. $Э_о=Ц_п-С_ф-П_о$. If $Э_{сз} > 0.66Э_о$, then $П_д=0.66Э_о$.

With allowance made for what has been presented the following system of the formation and distribution of the balance sheet profit of organizations is proposed (see Table 4).

The implementation of the proposed model will make it possible to include the category of the profit among the active components of the system of cost accounting of sectorial scientific and technical organizations. A cost accounting source of incentives for the workers of scientific production subdivisions for the fulfillment of the current (quarterly) indicators appears. Now it is in practice absent. The cost accounting responsibility for the failure to observe the planned deadlines of the completion of the work is established: the organizations in these cases should pay from the profit the increased interest for credit (4 percent per annum). At the same time material liability for the formation of above-standard balances of standardized working capital (including unfinished work) and uninstalled equipment is introduced. Since the additional deductions for cost accounting funds will depend on the amount of the profit, an interest in its increase and maximum use for the needs of the organization itself appears.

Table 4

Formation and Distribution of Balance Sheet Profit of Scientific and Technical Organization in System of Cost Accounting

Sources of formation of basic profit	Distribution of basic profit
1. Excess of estimated cost of work over actual expenditures (up to 3 percent of actual cost, but not more than sum in accordance with approved estimated costing)	1.1. Payments to budget from profit* 1.2. Covering of planned losses from operation of housing and municipal services 1.3. Outlays at expense of profit on economic maintenance of buildings, structures, parks, and Pioneer camps, which have been turned over for free use to trade union organizations 1.4. Unplanned outlays at expense of profit** 1.5. The remainder is distributed in equal amounts between the funds: of development of the organization and of the scientific reserve***

*In the amount of 10 percent instead of the prevailing 25 percent (in connection with the limitation of the amount of the basic profit to 3 percent, the establishment of the payment at the expense of the profit of increased interest for credit, and the proposed introduction of a fee for above-standard balances of assets).

**Payments to the budget of the fee for above-standard balances of standardized working capital and uninstalled equipment, the payment of increased interest for bank credits.

***It is proposed to establish a fund of the scientific reserve.

[Table continued on following page]

Table 4 (continued)

Sources of formation of additional profit	Distribution of additional profit
2. Saving of wages and deductions for social insurance with respect to work completed ahead of time (not more than 10 percent of planned time)	2.1. Within annual saving on wage fund of organization--to the material incentive fund 2.2. For payment of bonuses in accordance with all-union socialist competition 2.3. The remainder (which was left after use in directions 2.1 and 2.2) is distributed in equal amounts between the economic stimulation fund and the fund of the scientific reserve
3. A portion of the assets from the sale of licenses for inventions. Assets from sale of technical specifications to unplanned clients	3.1. In the part intended for payment of bonuses to workers--to the material incentive fund 3.2. The remainder is credited to the fund of the scientific reserve
4. Assets received from payment of penalties, fines, forfeits	4.1. Credited to the fund of the scientific reserve (less penalties, fines, and forfeits, which were paid by the organization)

Here the procedure of forming the profit is strictly regulated. In the model proposed by us the possibility of deriving an additional profit arises on the condition that as a result of the shortening of the planned cycle of work a saving of the wages of the developers is achieved. In order to retain an interest in the decrease of the other items of expenditures (materials, energy, and so on) and to ensure a connection between the results of the work on individual themes and the end results for the organization as a whole, it is stipulated that the saving on wages is used in the amount of up to 66 percent of the total saving on the theme and within the total of the balance sheet profit of the organization.

Through the distribution of the profit the sectorial scientific and technical organizations are linked with the financial system (the fee for above-standard stocks) and the State Bank (the increased interest for work which has not been delivered on the planned date), which, consequently, monitor the current activity of the organizations. Thus, the formation and distribution of the profit is built into the cost accounting mechanism of sectorial science.

The suggestion to include in the estimated cost of the work a profit at the level of 8-10 percent of the planned cost of the development might seem simpler. However, in this case it will not be linked with the stimulation of the early delivery of the completely finished work and with the saving of labor and material expenditures. The basic objection of the opponents is that the developers will strive to overstate the estimated cost of the work. But such an aspiration also occurs under existing conditions (insurance against miscalculations), it would also be retained in case of the planning of the profit at the level of 8-10 percent. For the neutralization of the trend toward the unfounded lengthening of the cycle of developments and the overstatement of their estimated cost it is necessary: to increase the liability (administrative, material) of the developers and clients; to introduce in the system of the management of research and development the appraisal of the duration and estimated (actual) cost of important jobs (for example, more than 3 years and over 100,000 rubles).

The conversion of the process of reproducing fixed capital to a cost accounting basis should become a significant factor of the improvement of cost accounting in sectorial science. At present estimated budget methods are used at sectorial scientific and technical organizations in case of the planning and financing of capital construction, as well as the acquisition of equipment, instruments, and devices. This leads to a number of negative consequences: the compensation for the wear of fixed capital and its replacement are not in a standard dependence on the value of the capital and the time of functioning with allowance made for the scientific sound norms of its operation; there is no stable, systematically formed source of the financing of the compensation for and replacement of fixed capital; the range of deviations of the actual capital investments, which are attributed to the cost of research and development, from the accounting amount of the amortization deductions is very significant--both within organizations (by years from +98.5 to -11.8 percent) and, in particular, between them (from 5.6 to 110.3 percent with respect to the surveyed organizations); the expenditures of past (embodied) labor, which are liable to inclusion in the

cost of the performed research and development, are distorted; the sectorial scientific and technical centers are deprived of a substantial source of the formation of the development fund of the organization. The importance of the last factor increased in connection with the fact that the introduced 3-percent limitation of the excess of the estimated cost of research and development over its cost blocked the basic channel of the entry of assets into the development fund.

All these negative phenomena can be eliminated, if amortization deductions are introduced at sectorial scientific and technical centers. The most serious objection, which is advanced against such a solution, is connected with the fear that it can cause an increase of the expenditures on research and development. The study made by us showed that the amount of the additional expenditures, which are liable to inclusion in the cost of the work being performed by scientific and technical organizations of the electrical equipment industry, will come to 3.7 percent. This is offset to a significant extent by the restriction of the upper limit of the deviations of the estimated cost of the work from the actual cost to the amount of 3 percent. Such deviations according to the data of the consolidated reports of the organizations of the sector came in 1970 to +7.5 percent, in 1975 to +5.03 percent, and in 1984 to +5 percent.

Other directions are also of great importance for the most complete use of cost accounting for the purpose of increasing the efficiency of sectorial science: the changeover to a cost accounting system of the financing of sectorial science, which is based on the circulation (turnover) of capital; the introduction of a scientifically sound set of cost accounting indicators of the activity of sectorial scientific and technical organizations; the improvement of internal cost accounting, the organization of the systems accounting of the actual efficiency of new equipment; specific forms of the formation of an efficient system of the extension of credit to scientific and technical organizations, which combines in an optimum manner the use of internal and borrowed capital and is oriented toward the strengthening of the interaction of financial and credit levers in the interests of the acceleration of the development of new equipment.

All these directions need detailed examination for the making of decisions on the further improvement of cost accounting in sectorial science.

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RELIABILITY, SAFETY OF NATIONAL ECONOMIC COMPLEXES

Moscow NTR: PROBLEMY I RESHENIYA in Russian No 19, 7-20 Oct 86 pp 4-5

[Interview with President of the Ukrainian SSR Academy of Sciences Academician Boris Yevgenyevich Paton, twice Hero of Socialist Labor, by F. Vladov, under the rubric "The Problem Close Up": "The Safety of Progress"; date, place, and occasion not given; first paragraph is NTR: PROBLEMY I RESHENIYA introduction]

[Text] The increase of the power of mankind should be accompanied by the leading increase of the responsibility for its accomplishment. Speaking on Soviet television, M.S. Gorbachev specially noted that "under the conditions of the further development of the scientific and technical revolution the questions of the reliability of equipment and its safety and the questions of discipline, order, and good organization are acquiring vital importance." The questions of the assurance of reliable and trouble-free operation are arising with particular urgency with the establishment and functioning of large national economic complexes. At the request of the editorial board well-known Soviet scientist, President of the Ukrainian SSR Academy of Sciences, and twice Hero of Socialist Labor Academician B.Ye. Paton reflects on these problems.

[Question] Boris Yevgenyevich, why does the traditional approach to evaluating reliability, which has given a quite good account of itself in the production of individual parts and devices, prove to be inadequate when it comes to large national economic complexes?

[Answer] If only because the larger the complex is, the greater, figuratively speaking, the area of its contact with and the strength of influence on the environment are, the closer the connection with its various components is, and the "more extreme" the consequences of failures and malfunctions are.

It is impossible to isolate such a complex from the environment, under the conditions of which it has to function. Nevertheless the transportation network, for example, should operate in both hot and cold weather, continuously delivering cargo even under the conditions of natural disasters. The demands, say, on a machine tool, even of the highest performance and precision, are different. If it ceases to work as a result of a fire, it would hardly occur to anyone to blame its designer--for he did not reckon on

the operation of his creation in a flame. But is as a result of a fire an accident occurs at a chemical plant, harmful chemical substances will escape, contaminating the surrounding flora and fauna. Here it would be completely logical to call the designers to account for this: their duty is foresee such a case, to envisage all the means of its prevention. And even of the elimination of the consequences, if all the same it occurs.

On the other hand, the very emergence of a large complex is always an encroachment on nature. We can foresee its ecological consequences in far from all cases. But even when we can, we do not always consider them. Thus we continue to multiply the examples by which it is possible to illustrate the correctness of F. Engels, who warned: each victory over nature "...has, true, first of all, the consequences on which we are counting, but second and third of all completely different, unforeseen consequences which often destroy the significance of the initial ones."

Fertile lands, which have been flooded by reservoirs or covered by strip mining dumps of mining enterprises, air emissions of chemical and metallurgical works, clearings which have been cut when laying high-voltage electric power transmission lines, petroleum and gas pipelines, highways and railroads. All of this is payment for our sometimes "pyrrhic victory" over nature. Often it is even not the entire payment, but only, so to speak, the first installment. For all "accomplishments" of this sort are only the beginning of a long chain of consequence, each link of which submit to us at one time its bill....

The total cost of a major complex is determined far from only by the direct expenditures on its establishment. The ecological losses, which inevitably accompany its inclusion in the "ecoindustrial" system, must be taken into account. Thus, the reliability of such a structure, even during its normal trouble-free operation, should include without fail the task of safeguarding all elements of the environment surrounding the complex, which should be protected from the influence of this complex. In other words, the reliability of a major national economic complex is the reliable protection of its surrounding environment from it. And, of course, the people who are engaged in its operation or have simply been settled in its vicinity.

And this is understandable inasmuch as any such complex has been provided with a huge energy potential, a high concentration of dangerous radioactive or chemical substances and a concentration of large heat or water resources exist here, or there is a combination of similar factors. A loss of control over any of them is nearly always a misfortune both for people and for the economy.

This in principle changes the very approach to evaluating reliability. Whereas with reference to an individual part or even a large unit when determining the level of reliability they usually proceed from the fact that its further increase is inadvisable--it is easier to make a replacement or repair--when changing over to complexes the criterion changes. The typical evaluation like "the probability of system failure in a year is equal to 0.001" can no longer suit us, since, as systems engineers sadly joke, "even the least probable event is sure occur one day." But in this case the

ecological and medical consequences of an accident can far exceed all the expenditures of creating and operating the complex.

Here there is no other way out but to strive for absolute reliability and exclusion of the very possibility of individual failures. If the possibility of such failures is overlooked, this is a sign of an incorrect design solution. When modifying a design, it is necessary either to eliminate the cause of the breakdown or to envisage special means on the elimination of its dangerous consequences. If neither of these is possible--for example, is too expensive--then one should, at the least, temporarily abandon the implementation of such a design.

This applies especially to global projects, whose getting out of control is fraught with the danger of the destruction of a significant portion of or even all of mankind. This applies, say, to projects connected with weapons of mass destruction. To say nothing of their fundamentally antihuman orientation, such projects should not implemented simply because of their enormous potential danger.

As to ordinary large complexes, although their absolute reliability, unfortunately, is unachievable, it is necessary to strive precisely for it, often by venturing the greatest expenditures. For a saving here here can lead to truly devastating losses.

Let us take such a semifantastic project as the conversion of solar energy on a satellite into electric power with its subsequent transmission to earth. I say "semifantastic" not for nothing--in principle there is nothing impossible in this. Today such a method is regard when working on the energy problem as one of the alternative methods.

Imagine a satellite permanently stationed 36,000 kilometers over a given point on the earth. Using widely spread "panels" of solar batteries it collects the sun's tremendous energy and transmits it to receiving stations on earth in the form of microwave radiation. We will assume that all the necessary equipment has been developed and that the project is feasible.

Now come the reliability problems. For a kind of "blasting fuse," which has been stretched from the satellite to earth, passes through the atmosphere. Hence, it should be insensitive to gales and thunderstorms, air eddies and temperature variations. The reliability of power supply depends on this. It is a substantial circumstance.

But it will fade, if this "fuse" itself begins to overheat the atmosphere, spawn cyclones, propagate radio interference, and so on and so forth. Finally, it is frightening also to think about a single failure in any of the links of the "satellite--transmitting and focusing equipment--receiving station" chain. Such a failure is capable of having the result that vast--hundreds and thousands of megawatts--energy will get out of control. After all, it will literally tear to shreds everything living and nonliving on an area of many kilometers.

[Question] So, should such projects be rejected?

[Answer] You would hardly reject them, if the depletion of assimilated energy resources promises global darkening and cooling.... But since you would not reject them, it is necessary to think about reliability. It is necessary to "measure off" here not 7, not even 77 times, but hundreds and thousands of times before "cutting" once!

[Question] But is it possible to insure against even isolated failures and by means of new, nontraditional methods to achieve the safety of large complexes?

[Answer] At the least I would like that, and I will attempt to formulate some suggestions which should help to achieve this goal.

The first of them pertains to the predesign stage and is based on the obvious thesis that the safest complex is the complex...which does not exist. At first glance it sounds simple: "Before starting one project or another, think about whether it is impossible do without it." But it is sufficient to recall the dispute, which recently concluded favorably, on the project to divert the northern rivers. The passions around the question seethed for a long time. However, it was impossible at any time to call all this a dispute, since the "exchange" of opinions was "one-way." And then a decision of the Politburo of the CPSU Central Committee on halting all work on this project was finally adopted. The sensible forces won in this case, but, unfortunately, it does not always happen that way.

The drained waters of Lake Sevan, the level of which they are attempting to restore with tremendous expenditures, the disturbances of the ecosystem in Kara-Bogaz-Gol Gulf of the Caspian Sea, and the pulp and paper combine on Lake Baykal, which is suffering already today from a shortage of raw materials, are only fragments of the list of unnecessary national economic complexes. They are not simply ruining the conditions of ecological safety, they are also not fulfilling their immediate national economic functions.

[Question] What about the managers who made the corresponding decisions and implemented them--did they not know about the reality of such consequences?

[Answer] Well, I do not presume to judge whether or not they knew. But in any case it can be asserted that these decisions were made under the strongest departmental, often immediate interests, while the openness of the discussion was, to put it mildly, severely limited.

We are still feeling some departmental pressure today as well. Let us take, say, such an urgent question for the Ukraine as the construction of the Danube-Dnieper Canal. I do not want to make any predictions at this time. At present a special commission is working at our academy. Its task is the comprehensive evaluation of this project.

But here is what is interesting. The project for the present has not been approved, while the State Commission of Experts of the USSR State Planning Committee returned even its technical and economic specification for modification. But the construction works have already begun to start the

preliminary work. In other words, the activeness of the position of the corresponding departments does not arouse any doubts.

Meanwhile more and more valid doubts about the very necessity of this canal are arising. Total water consumption in the republic has increased by more than twofold in the past 25 years. According to recent assumptions it should grow by about another 1.5-fold by the year 2000. The diversion of Danube water is designed, strictly speaking, to meet these increasing needs.

But is it necessary to tolerate the very increase of this need? For it is actually a consequence of the extensive approach to the consumption of the most important national economic resources, which is encouraged by the illusion that it is free.

The experience of other industrially developed nations shows that, beginning approximately in the 1960's, their water consumption has practically not increased, although industry is developing and the area of irrigated lands is also increasing.

There is no paradox here. Low-water or else simply waterless technology, water recycling, and drip irrigation are simply being used more and more extensively. In other words, the most valuable thing is intensification.

For example, in Sweden, when state water consumption norms were introduced, enterprises of the pulp and paper industry reduced water consumption to one-thirtieth to one-twentieth! Such is the force of interacting saving and intensification.

But this is our situation today! Incidentally, in spite of the noted increase, is our water consumption, perhaps, relatively less than in other countries? Unfortunately, it is not--it is greater. And often much greater. Not without reason in the same decree, which put a stop to the hankering to divert northern rivers, is the task posed not to increase, but, on the contrary, to reduce water consumption in the national economy by 15-20 percent.

The next assumption is that it is necessary to beware of "unplanned," spontaneously arising complexes.

[Question] Please explain what you mean.

[Answer] Any of us know how to answer the child's question: Why must you not pick a flower from the garden? Unlike an infant, we understand very well that if everyone begins to pick from this small garden.... But where does our understanding disappear, when rivers, forests, fields, and meadows are before us? We simply cannot get accustomed to the idea that today our entire earth is the same garden and if everyone were to begin....

At one kolkhoz, while expanding the plowed lands, they plowed up the fields to the river itself, up to the waterline. Having been left without protection of the banks, the river quickly began to overflow, grew shallow, and in the end dried up. Just think, one river, and not a river at all, but a stream, a

creek. This, I am afraid to say, is a typical reaction to similar stories. But in pursuit of crop land a neighboring kolkhoz, and another one, and another...acted in the same way.

Here as if a complex, which seems not to have been established by anyone, but all the same very efficiently...destroys small rivers, began to operate. And there is no longer the collection from enormous areas of the moisture of atmospheric precipitation, which, among other things, feeds large rivers and reservoirs. But many of the small creeks need help, moreover, you will no longer help some. And there is no one to call to account: no one planned this, no one is answerable for this, everyone as if plowed up just "his own" river....

Or there is another thing. Irrigators in the southern Ukraine pour and pour water. Irrigation equipment is operating nearly around the clock, rain or shine. But how can it be otherwise? The wages of irrigators often directly depend of the quantity of water poured. It comes as no surprise here that there is beginning to be not enough water. Here is a pretext for you for projects like the mentioned Danube-Dnieper Canal. And they contemplate such a thing even without considering that the land itself is no longer coping with such an abundance of water. While it has nowhere to run off--let us recall once more the plowed up rivers. And the flooding of vast territories begins. On hundreds of thousands of hectares of fertile land, with scores of populated areas the ground water level has risen nearly to the surface of the land. Cracked foundations, flood cellars, collapsed structures, rotting roots of plants and trees. In short, the "flooding complex," which as if emerged spontaneously, is again doing the most serious economic harm.

It is necessary to combat similar "complexes." Moreover, it is necessary to learn to avert them!

[Question] Let us return to planned, no longer with quotation marks, national economic complexes. What demands on their reliability and safety are most vital?

[Answer] It should be envisaged already at the stage of designing: everything that is used or produced at the complex--raw materials, materials, energy, heat, water, and so on--all this should go from here into the environment only as finished products (including intermediate products which are being sent for further processing). Everything above this should be returned without fail for reuse. It would seem that this is simply the well-known principle: a good manager wastes nothing. But here the very essence lies in something else. Sad experience irrefutably attests: committed, but unused or even not completely used resources are not only a lost profit, but also discovered warnings, science these resources, which have been released from control, are a very likely source of danger. For the monitoring of them, as a rule, is inadequate, and the consequences can prove to be simply unpredictable.

A new school building near one of the large electrical power plants collapsed.... Luckily it was at the end of summer vacations--no children were injured. It was all due to the fact that the plant was built on readily

soluble limestone soil. The choice of the site was unsubstantiated and the reliability of the structure was reduced from the start. Hot water--the "waste product" of production!--being cooled, but only partially, in the cooling towers, entered the soil, where it drastically stimulated karst processes. The limestone began to dissolve, subsurface voids, one of which almost became the cause of a tragedy, appeared.

And how many accidents are connected with flammable piles of waste products of the wood working or chemical industry, how much land disappears for a long time and sometimes forever under the dumps of mining pits, under the ashes of thermal electric power plants, and under the surplus area of water reservoirs without embankments?

We are approaching as if the other side of the same rule. In a complex there should not be anything extra, including extra territory.

Let us take a look at the Kiev Reservoir, for example. It supplies water to agricultural and industrial enterprises, supports shipping, and so on.

But why is it so big--almost 1000 square kilometers? At one time there was a plan to bank up this reservoir. But when they reckoned the cost (it turned out that this would cost several tens of millions of rubles), they decided to withhold acceptance. They saved, so to speak.

[Question] And what is the result?

[Answer] Well, first, the most fertile marshlands and flood plains were flooded. Second, the reservoir became shallow and in summer the water began to get very warm. Then the abundant organic residue of flooded plants on the bottom rapidly became covered with algae. The regrettably well-known blue-green algae appeared--moreover, in enormous quantities. They poisoned the water, wiped out the fish, and in a number of places made the Kiev Reservoir unsuitable for the recreation of workers.

I believe that the value alone of crops not harvested in the ensuing years has already greatly exceeded the millions not spent on time. Of course, now that we understand this, embankment will be much more expensive: preliminary draining, work in swamps, soil reclamation, the restoration of the agricultural infrastructure, and so forth--all this is very costly. Nevertheless it is not ruled out that all the same this will have to be done. At least for a portion of the of the Kakhovskoye Reservoir--the former Konskiy Flats--which proved to be in the same kind of situation, the study of the corresponding versions is already being carried out.

[Question] Apparently, a comprehensive scientific approach to the technical and economic substantiation of projects should help to avoid similar errors. But today you will probably also not find a project of the least significance, on which scientists are not working. So what is the matter here?

[Answer] Unfortunately, their work and a truly scientific approach are not always equivalent concepts.

The analysis of high-quality primary information, the elaboration of coordinated recommendations, and the making of the corresponding decisions.... There are only three links in this chain. But each of them is vulnerable in its own way.

Let us start with the first one. We are already used to the fact that there is constantly not enough information. Is that the case? Both yes and no.

Indeed, when you begin to "attach" one project or another to specific conditions, say, to a specific site, nearly always there are insufficient data first on its geological features, then on the vegetation, then on the water balance, then on something else. And the first precepts, to which one has to become reconciled in this case, is that fact that one must not spare assets and time on seeking these data.

The power concentrated in man's hands today is so great that it is simply criminal to put it into action, without imagining all the consequences, to work, so to speak, "on the off-chance." Therefore, it is necessary to be prepared in advanced so that the preliminary study of the project would cost as much, or else more, than its implementation. Knowledge is expensive, but a lack of knowledge is even more expensive! This is a new trait of modern designing, and it is necessary to look at it with open eyes.

But will this always be the case? This is debatable. For if in principle we can obtain comparatively exhaustive information from nearly any site, it probably makes sense to collect it in advance for the entire surface of the planet, to put it in some data bank, and to continually update and use it as needed. Of course, such work requires tremendous capital investments, but much effort and labor its results will save in the end!

This type of experience already exists. In eliminating the consequences of the Chernobyl accident we succeeded in combining the capabilities of the latest computer equipment with the data, which had been accumulated in various departments and pertain to the region of the nuclear plant. The task was a difficult one. Under ordinary conditions years would have been spent on accomplishing it--the comparability of the data, a common form of presentation of the results, the rejection of distorted information.... But in those days we all the same set to work on it. And the results proved to be astonishing.

Maps of various sectors of the accident zone began to appear before the eyes of specialists of different types, who gathered before the screens of Delta mega-minicomputers. What maps they were! By examining them one can learn everything about every point: the nature of the vegetation, the soil composition, the ground water level, the topography, and much, much more. With the use of these maps it became much easier to make the necessary decisions: the engineer found common ground with the medical man, the physicist--with the hydrogeologist.

Even more impressive were the results of the joint work in what is called "situation room." Here various processes were "played out" in an interactive mode on a dynamic model of the Kiev Reservoir and versions of the consequences

of some engineering solutions or others were compared almost immediately on a large screen.

[Question] In my opinion, these are already problems of the second link--the development of joint coordinated recommendations. As I understand it, scientists can differ according to their level of knowledge, can belong to different, including opposing schools, and can defend departmental, regional, or other business positions. Finally, they can simply pursue their own interests. Much is being said and written about all this. Numerous appears for the objectivity of sciences are being heard, they are appealing to the ethics of the scientist.

[Answer] Of course, it would be very nice if all scientists fully possessed civic conscience, and it is very unfortunate that for the present this do not exist. But some of them can also sincerely err, confusing thereby the people who make the decisions.

It seems to me that, without forgetting ethical categories, it is still necessary to seek the solution in something else. It is necessary to improve the process of making and coordinating group recommendations on large national economic complexes so that mistakes would in practice be eliminated. For this all doubts should be considered and the opinion of all participants in the discussion should become common. And the most promising means to this is simulation models and interactive expert systems based on them.

It is possible to exchange letters--especially official ones--for a long time, while elucidating a special question, it is possible to argue for a long time, while discussing a general question, but never come to a common opinion. However, it is very difficult to resist the obviousness of a model. Equipment is a concrete thing, and if a sufficiently good model of the complex being designed exists, by introducing into it one debatable solution or another, you will easily see the inevitable consequences to which it will lead.

Under these conditions--and most often they become clear in the "situation room"--it is very difficult to defend without proof market considerations, and they rid themselves incomparably more easily of sincere errors. True, it is very difficult to create such models, and they are expensive. But this is precisely the case when today's saving can become tomorrow's losses.

Therefore, for the achievement of high reliability the development of the appropriate simulation model should precede the construction of each large national economic complex. Gradually being developed and becoming more complicated, it will accompany the complex throughout the time of its designing, construction and operation.

Well, what about the third link in the scientific approach to designing---"the making of the appropriate decisions"? Here at times the most regrettable surprises also lie in wait for us.

The necessary information has been collected and analyzed. Highly skilled scientists and specialist have finally reached a common opinion. The competent experts have confirmed--build it, and build it here.

But...here the local authorities suddenly thought. How is it here? We have, meanwhile, a construction base 50 kilometers from here, the basic manpower is there, the living conditions are at little better. And they are being to build...there.

Incidentally, that is approximately what happened with the above-mentioned electric power plant, next to which the school building collapsed. For scientists repeatedly warned that it must not be built on karst soils, they proposed another, reliable site for construction. But they did not take their recommendations into account.

That is what is most frightening. Indeed, science still cannot do everything. There are such unforeseen situations, in which scientists for the present cannot make verified predictions and recommendations. But wherever such recommendations exist, ignoring them is the worst type of irresponsibility.

I have already mentioned the erroneous decisions connected with the northern rivers, Lake Baykal, and Lake Sevan. Other examples can also be cited. One thing unites all of them: there were always scientists who actively, and as it subsequently turned out, validly objected to these decisions. And they did not simply object, but in each case proposed different, more sound and reliable versions. However, the management of the corresponding sectors most often simply did not take the opinions of these specialists into account. While at times they were also glossed over in every possible way.

The decisions were made in secret, without "outsiders." No publicity--in this, in my opinion, lies the basic cause of the occurrence of similar situations.

Openness is now becoming an integral element of our life, and the situation is changing. The times of libertarian decisions, which are aimed at deriving an immediate advantage, for which it is then necessary to pay dearly, are passing. And the greater our, Soviet scientists', responsibility is for the soundness, reliability, and safety of the most important national economic decisions.

[Question] The safety of the complex should be incorporated in the design. This is self-evident. But, apparently, if the designed means of preventing malfunctions, failures, and accidents do not get into the consciousness of the executors of the design and do not begin to regulate strictly their actions, the frequent, to our sorrow, situation, about which they have said among the people from the earliest of time: "On paper there had seemed no hitches, forgotten were the ditches," will inevitably arise.

[Answer] So, let us talk about these "ditches," into which even the best design solutions often literally fall. They fall precisely because daring has not become the rule here--to look into these very "ditches" and to display ordinary circumspection. It is necessary, in turn, to envisage it not only within a quite rigid legal framework, but also to place it on a scientific basis.

First I will touch upon the legal aspect of the matter. It, I am convinced, should rest, frankly speaking, on the exclusion principle, which legally prevents any deviations from an approved design. And partial changes deviations, which do not affect the key properties, and first of all the safety of the designed object, are to be allowed only as an exception. All types of discipline--the discipline of deliveries, executive discipline--should rest firmly on such a base. And, of course, administrative discipline, which is connected with the fact that the state delegates to the manager, who organizes the implementation of the design, its own authority only for its persistent fulfillment. Any changes in the design should belong only to the competence of the designers.

Here the smallest compromises, in the spirit of ones which "have made one sick and tired," are also intolerable. For example, the design stipulates concrete of brand 500, but they delivered brand 300. Neither the superintendent nor another, even a lofty, official has the right to use it, at least without the assent of the designer. Only he can know to what "emergency consequences" a substitution can lead.

But how frequently we are faced with dangerous deviations from the design, which you would not call accidental. Precisely the fact that they are of a purposeful nature makes them dangerous. Usually everything begins with the fact that the majority of construction projects for various reasons are not included in the initial estimate, they do not have enough construction materials and manpower. In this way the intolerable process of "simplifying and reducing the cost of" the complex begins.

Here the considered opinions of tens and hundreds of specialists are often ignored. Somehow unnoticed, without extensive discussion, in 1 hour they delete from the designs what the most competent specialists have introduced. competent specialists are removed from the design in the course of an hour. With courage worthy of better application, people make decisions which they do not have the right to make. And as a result, when emergency situations all the same take shape, we may find ourselves--and, unfortunately, sometimes do find ourselves--inadequately prepared.

[Question] Emergency situations.... It would seem that everything possible is being done so that they would not occur, but, having occurred, would be eliminated quickly, without serious consequences. For this the most important assemblies are backed up, interlock systems turn off devices in case of incorrect actions of personnel, and special sensor keep track of the temperature, the gaseous atmosphere, and other parameters and if necessary immediately switch on the appropriate final control elements....

[Answer] But airplanes crash, ships collide, fires break out, and explosions occur. And there is no divine providence behind this. Each time special commissions find that entirely earthly causes: equipment failure, erroneous actions of people, unforeseen external influences, were the basis for the accident. Therefore, while intensifying in every way the work on the prevention of emergency situations and providing for everything possible and impossible, so that they could not occur, we should nevertheless be constantly prepared for them to occur all the same.

One must not, I believe, shut one's eyes to emergency situations. It is necessary to predict them in all their probabilities and improbabilities and to model them. And in accordance with a special program to train personnel on such models. Then even a surprise will be less surprising and the unknown will be more understandable.

In large systems an accident, as a rule, is only the end of a more or less long chain of events which result from each other. While one inconspicuous disturbance or another of the normal operating conditions lies at the beginning of this chain. The task of the designer is to study all such sequences in advance and for each one to envisage the mandatory breaking of the chain. And then, no matter with what the accident began, it will not lead to a tragedy.

The operator, of course, should also visualize the probable course of events. But for him the main this is to know what he should do at each specific moment. The lack of time will not allow him to ponder long, the control of the accident should be carried out almost automatically. This automatism should also be developed in "model drills."

The sources of accidents and the different versions--from a burnt microcircuit to a natural disaster--should be checked precisely with the aid of models. The responses of operators to all possible alarm signals should developed on the basis of models by means of special simulators, being brought up to automatism.

Models, test beds, simulators, numerous redundant and protective units--all these components of the reliability of a large complex should become an integral part of the design.

They do not take a direct part in the production of the basic product, and, therefore, many managers for the present have not yet overcome the obsolete attitude toward them as something secondary. This is fundamentally wrong. Only the thorough study of all the aspects of reliability and...unreliability of a large engineering project makes it truly efficient and safe.

In responding to the questions of the editorial board, I did not touch upon many aspects of the problem under discussion. This is natural--it is easy to tell only about what is well known. But for the present there is no theory of the reliability of large national economic complexes. They are just beginning to elaborate it. But the needs of practice are urgently calling for its development. While they, as is known, advance science more than 10 universities.

12746
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AUTOMATED PROCESSING OF PATENT INFORMATION

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[Article by B. Kurakin, deputy chairman of the State Committee for Inventions and Discoveries]

[Text] The course of national socioeconomic development prepared by the 27th CPSU Congress is based on an essential acceleration of scientific and technological progress and the widespread introduction of new generations of equipment and fundamentally new technologies providing improved labor productivity and overall production efficiency. The tasks put forth require an in-depth technological reconstruction of the national economy based on the latest achievements of science and technology. This in turn makes it necessary for each branch, enterprise and association to develop a strict program of constant production renewal. They must first define the areas and sectors which can provide the greatest impact at minimal costs.

Machine building has a dominant and critical part to play in the scientific and technological revolution. For this reason a great deal is planned for accomplishment during the current five-year plan. Its growth rate must be increased 1-1/2 to 2-fold, capital investment in machine building must be increased 1.8 to 2-fold and the output volume of modern equipment types must be sharply increased.

The task of mass producing new generations of equipment capable of markedly increasing labor productivity and opening the path to automation of all stages of the production process is a particularly important one. The organization of integrated delivery of equipment and production lines is of extreme importance here, as is the organization of an in-house repair and servicing capability for this equipment.

A qualitative solution to these problems requires the active redirection of science toward the needs of technological re-equipment. Science must be brought into closer contact with production. Academic and branch institutes must be increasingly supplied with the scientific potential trained at VUZs.

The factory sector of science deserves special attention. This sector is closest to production, is an organic part of production and, as experience shows, can substantially reduce lead times for the development and production

of new equipment. The 27th CPSU Congress discussed this very type of interaction. The largest enterprises in the nation--Elektrosila, Uralmash, the Ivanovsk Machine Tool Building Production Association and others--owe many of their achievements to a tight fusion of science and production and to the efforts of factory scientists, designers and production engineers.

It is also important that production turn toward science and be fully receptive to the achievements of science and technology. Indeed it must be said that there are very few scientific discoveries and major inventions that will not find practical application for years or sometimes for decades.

The 27th CPSU Congress' decisions were further developed in the recent resolution adopted by the CPSU Central Committee and the USSR Council of Ministers on "Measures to Fundamentally Increase the Quality of Products." At the present stage of economic development a fundamental increase in the quality of products is the most important practical task facing party, management, trade union and Komsomol agencies, associations, enterprises and organizations. A decisive break in this direction is required now at the start of the 12th Five-Year Plan and a set of organizational, economic and legal measures must be put into place.

The resolution stated directly that, in the creation of machines and equipment, scientific research and design organizations and enterprises will be fully responsible for implementing advanced requirements for new technology. Associations and enterprises will be responsible for product quality, product competitiveness on the world-wide market and compliance with the strictest demands on the part of new products and materials. Now the quality and technological standard indicators are definitive in the evaluation of management activity results and the formation of economic incentive assets for collectives.

The role of the consumer is increasing. The consumer has obtained the right to unilaterally cancel contractual arrangements with a supplier in the event of repeated delivery of low-quality products. In such a case the supplier must suspend or cancel manufacture of those products and compensate the consumer for losses incurred as a result of cancelling the contract.

Replacement is inevitably required in the case of a failure due to low-quality products and materials. Under these circumstances the consumer must have strict guidelines. Accurate and reliable information is mandatory here. That is why the State Committee for Science and Technology, the USSR Academy of Sciences and the State Committee for Inventions and Discoveries have been given the task of fundamentally reorganizing the nation's information service and creating an effective system designed to provide informational support for promising scientific research and technological developments.

The importance of patent information, the foundation of a data base needed to objectively evaluate the worldwide standard of scientific and technological solutions, is growing immeasurably. Today correctly performed patent information work is one of the most important factors in the achievement of high scientific and technological standard indicators for research and

development, the quality of industrial products based on this research and development and the competitiveness of these products on the world market.

The recent common tendency in the leading nations toward "informational economics", where knowledge and information are becoming the key to development, must be studied. An increasing share of resources is being expended on knowledge and information. There are already 2800 data banks in the world and 300 of these contain patent information.

This great attention to data banks, and especially those containing scientific, technical, business and economic data, is explained by the fact that an optimum capacity for storing and processing these data provides a government with political as well as economic advantages. Thus we have the rise of the "informational expansion" concept as a result of the uneven development of transnational data flows.

The factors mentioned--both intragovernmental as well as external economic factors--clearly confirm the highly critical nature of the problem. At our nation's breakthrough stage of socioeconomic development, occurring in conditions of extremely complex external political relationships, it is absolutely essential to critically evaluate the state of affairs in patent information work and to define a means of fundamentally reorganizing this work.

During the last five-year plan central, regional and sectorial agencies created an extremely large patent information base made up of more than 100 regional and over 5000 sectorial assets. At this time there are nearly 700 million patent descriptions (with an annual growth rate of about 40 million documents) in these facilities as well as in all-union patent offices subordinated to the State Committee for Inventions and Discoveries. Each year nearly two million specialists in all branches of the national economy are serviced and some 10 million copies of documents are prepared at their request.

Both the volume and quality of centralized patent information processing have increased. Lead times for publishing reports on Soviet inventions have been cut in half. The situation of the Patent Information Scientific Research Institute's "Izobreteniya stran mira" [Inventions of the World] publication is different. The number of requests satisfied has nearly doubled and the number of patent investigations has increased nearly fivefold.

Of no less importance is the fact that an increasing proportion of centralized servicing is handled by an automated patent search and analysis system. This is a fundamental characteristic of the times. At the "Poisk" [Search] Scientific Production Association there are data banks for multifaceted searches of inventions registered in the Soviet Union and abroad, analogous patents and trademarks. Television technology is being adapted for access to the data banks.

The number of collective subscribers to the magnetic tape service has doubled. The number of on-line invention data end users has grown fivefold and includes more than 4000 organizations. Based on these services a number of the nation's

information centers have organized a document search capability with subsequent preparation of copies.

The first steps have been taken toward in-depth automation of patent information processing which is so necessary for evaluating the current level and future development of technology. Nearly 600 thousand patent investigations have been carried out at the nation's organizations and enterprises. With the activation of an all-union state standard defining a patent investigation procedure, information support has become a necessary component in scientific projects and the creation of modern equipment has become unthinkable without the deliberate use of patent information.

The first five-year Program for Development of the Government Patent Information System established by the state committees for Science and Technology and Inventions and Discoveries has played an important role. Eighty-seven organizations, including 51 sectorial and 36 regional science and technology information agencies, participated in the performance of 50 program assignments. Their operations were coordinated by the State Patent Information Council and its Board of Users of Patent Information on Machine Readable Media (which has the powers of a section). There were many meetings of these agencies and their controlling offices at which useful decisions were made.

This type of interaction and cooperation provided the basis for organizing automated patent information processing at sectorial and regional centers, rendering scientific, technological and organizational assistance to scores of information agencies, enterprises and institutions and providing these latter with the technical documentation and operating experience developed by automated system and service institute specialists. The total economic impact of this activity amounted to several tens of millions of rubles.

In spite of these isolated successes, the level of patent information support for the research, development and management of scientific and technological progress still does not meet the demands placed on patent information agencies and services under the present conditions in which the nation's economy is being shifted to fast-track management.

The 27th CPSU Congress emphasized the urgent need for all-out improvement of product quality. The acceleration of scientific and technological progress and the elevation of production efficiency are an integral part of the resolution of this important task. The improvement of quality is an important problem for the national economy. It encompasses all sectors without exception and covers everything from the production of raw materials to final product output. Any solution must include the provision of information on the latest achievements in science and technology.

The goal set before enterprise labor collectives and party organization is as follows: new machines, equipment and instruments must meet or exceed the standard set by the world's best achievements. A jump in user information requirements is therefore expected. For this reason an evolutionary approach to information system development has already become unacceptable. A fundamental restructuring of the entire system, including its existing base, is needed.

The network of regional patent assets coming together in this country is not adequate for the informational requests of organizations and enterprises involved in creating new technology. In addition to good basic regional centers in Armenia, Latvia, the Ukraine and Leningrad there are still several poor centers which do not have adequate production space and equipment. These include those in Estonia, Uzbekistan and a number of RSFSR rayons. The assets of many major economic rayons, not a part of the basic system, don't even have the minimum number of descriptions of invention from the industrially developed nations. How can one objectively evaluate the world standard of any equipment developed without this? The situation that has developed is obviously counter to current calls for industrial product quality and competitive ability. Moreover, documentation which is not in demand continues to be accumulated.

One of the reasons behind this situation is the passive attitude of many central sectorial information agencies. They do not put forth the necessary activity for information centers in those regions where corresponding sectorial enterprises and organizations are concentrated.

It is obvious the most recent information must be available to USSR Gossnab agencies called upon to actively influence manufacturers. Stopping the production of obsolete, material-intensive and uneconomical products is the job of Supply and Sales Main Administrations which are responsible for expressing state interests and implementing scientific and technological progress in their respective fields. The future state of the economy and the growth of the nation's economic potential will determine what types of production will be allocated by them.

Here a great deal depends on the USSR Gossnab's regional agencies as they are located closest to the industrial enterprises. Also, they must basically evaluate products in terms of their quality and correspondence with the current technological standard. Frankly, this will not be easy to do without reliable and essential information.

The State Committee for Inventions and Discoveries is taking a number of urgent steps to improve the level of information supplied to interested organizations. Changes are planned in the system of outfitting and organizing regional and sectorial patent assets.

In accordance with the Program for Development of the Government Patent Information System, a restructuring of the nation's patent asset network is planned in order to concentrate its resources near the basic population of information users. There are plans for improving patent assets in the nation's major industrial centers by including descriptions of inventions from industrially developed nations and for creating several main inter-republic centers whose resources would be approximately equal to those in Moscow and Leningrad. At the same time there is the task of reducing redundancy in regional collections in order to orient them toward priority areas of economic development in each region.

A patent information system's efficiency is primarily determined by the intensity with which its data are utilized. Meanwhile, the current utilization level is in an unsatisfactory range. This is caused by a lack of correspondence between the growth in invention description volume and the capability for presenting these data. Consequently, an increase in the number of inquiry and search terminals, free access to stored documents, abstracts of these documents and rapid copying would correct this situation.

It is time to eliminate limited presentations of patent information on the whole as a means of facilitating the identification and registration of new inventions. Patent information is the developer's most important tool in the creation of new machines and manufacturing processes which exceed worldwide standards. Therefore, it is very important at this time to promote its use in determining technology policy in branches of the national economy. Following from this, organization and enterprise managers must bear in mind the basic questions of information availability for research and development and make timely use of patent information for control purposes.

The nation's economic structure is not indifferent to the type of patent information consumers. For example, last year nearly 10 thousand queries were from VUZ representatives (complicating any absolute evaluation) while only four thousand queries were received from machine building sector specialists. The State Committee for Inventions and Discoveries cannot avoid being disturbed by the building inertia. In the final analysis the matter is not one of volume indicators. It is infinitely more important for assets to be primarily used by those who determine the technology standard and quality of industrial products.

A question which actively affects the user--improving the "circumstances" under which assets are used--is now becoming especially critical today. This question is no less important than the creation of comfortable conditions for the user, including inquiry and search terminals, modern microfiche reading equipment and rapid document copying.

The republic institutes and regional information centers have a great deal to do in this area. They must immediately, deeply and carefully analyze the status of patent asset use and identify the organizations and enterprises which are prevented from patent research work. The formation at regional centers of boards made up of representatives from the region's leading organizations and enterprises will permit current shortcomings to be eliminated. Boards for economic and social development and for accelerating scientific and technological progress formed and being formed by CPSU obkoms must be included in this work. Regional and sectorial information programs, similar to the Intensifikatsiya-90 program successfully implemented in Leningrad, should be of assistance here.

A careful analysis shows that the majority of inquiries primarily involve domestic patent documentation. References to documentation from industrially developed foreign nations, which in many cases are the shapers of world technology, amount to only one percent.

This growing tendency must be fundamentally changed. A sharp increase in the demands for technological standards and product quality is making this objectively possible. As M. S. Gorbachev emphasized at his meeting with workers in the city of Tolyatti, shifting the national economy to fast-track development means not only bringing production up to the best worldwide standard, but also creating fundamentally new types of technology which exceed the technical solutions known until this time. High-quality patent information is called upon to help provide a qualitative solution to this problem.

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CEMA ACHIEVEMENTS IN STANDARDIZATION DETAILED

Moscow STANDARTY I KACHESTVO in Russian No 3, Mar 86 pp 16-19

[Article by Candidate of Economic Sciences A.A. Kirilenko, director of the CEMA Institute for Standardization, under the rubric "International Standardization": "Standardization and Socialist Economic Integration"]

[Text] At the present stage the implementation of the decisions of the Economic Summit Conference of the CEMA member countries, which was held in Moscow in June 1984, and the Comprehensive Program of Scientific and Technical Progress of the CEMA Member Countries to 2000 is the basic task in the area of standardization within CEMA.

As was noted at the conference and in the program, the utmost increase of the technical level, reliability, durability, and quality of products and the broadening and updating of their assortment are one of the key tasks of the economic policy of the socialist countries. In this connection it is deemed necessary to strengthen cooperation on the area of standardization and unification, since the CEMA standard has become the basic document which is intended both for the standard technical support of the corresponding tasks of cooperation and for the further development of the scientific and technical progress of each of the CEMA member countries.

Starting in 1982, the countries of the community signed a number of general agreements, in conformity with which work is being performed within the Council for Mutual Economic Assistance on the standard technical support of measures which promote the implementation of the priority directions of cooperation, for example, such ones as the development and the organization of the specialized production of industrial robots, the development and extensive use of microprocessor equipment, the establishment of the Unified Standardized Base of Items of Electronic Engineering, Special Technological Equipment, and Semiconductor and Special Materials for Their Production, and research in the area of flexible computer-aided manufacturing systems.

The CEMA Institute for Standardization actively participated in this work. It prepared, while the CEMA Permanent Commission for Cooperation in Machine Building (at present the CEMA Committee for Cooperation in Machine Building) approved a program of work on the complete standardization of industrial

robotic equipment for 1983-1990, which is aimed at the implementation of the General Agreement in the Area of Industrial Robots.

For the support of the General Agreement on the Development and Extensive Use in the National Economy of the CEMA Member Countries of Microprocessor Equipment the CEMA Institute for Standardization made an analysis of and generalized the experience of the CEMA member countries in the area of the use of microprocessor equipment (MPT) and took part in the formulation of a program of work for the period of 1986-1990 on the problem of microprocessor equipment, which was adopted by the CEMA Permanent Commission for Cooperation in Standardization. This commission approved the list, which was drawn up by the institute, of CEMA standards, national standards of the CEMA member countries, and standards of international organizations for standardization and the leading countries in the area of microprocessor equipment for their use in case of the standard technical support of microprocessor equipment within CEMA.

For the purpose of developing the work on the standardization support of the measures, which were envisaged by the General Agreement in the Area of Microelectronics, the institute made an analysis of the state of the standardization of items of electronic engineering. Procedural materials, which establish the principles of the formation and the structure of the system of CEMA standards and CEMA standard documents for items of the radio and electronics industry, were drawn up and adopted by the CEMA Permanent Commission for Cooperation in the Radio and Electronics Industry. A program of work on materials for items of electronic engineering for the period of 1986-1990 is being formulated.

The program of work on the standardization of FMS-type production systems for the period of 1986-1990, which is being formulated by the institute, is aimed at the implementation of the General Agreement on FMS-Type Production Systems.

In connection with the decision of the 37th meeting of the CEMA Session on the further expansion and improvement of the cooperation of the CEMA member countries in the area of the economical and efficient use of fuel and energy resources the institute prepared suggestions for the inclusion of the corresponding assignments on standardization in the program of cooperation of the CEMA member countries on the saving and economical use of material resources for the period to 2000. The institute also drew up and the CEMA Permanent Commission for Cooperation in Standardization adopted procedural instructions on standardization, which regulate the demands on the choice and the general rules of the inclusion in CEMA standards for products of the technical parameters and the indicators of energy consumption.

It is well known that the Economic Conference charged CEMA when formulating CEMA unified standards to use more extensively the best national and international standards, first of all, on products which are being specialized and cooperated, as well as to draw up suggestions on the development and implementation of a system of the evaluation of the quality and the certification of reciprocally delivered products on the basis of CEMA standards.

In this connection the CEMA Permanent Commission for Cooperation in Standardization and the CEMA Institute for Standardization at present are studying the questions of increasing the influence of standardization on the further increase of the effectiveness of scientific, technical, and economic cooperation. Their activity is aimed at the standardization and metrological support of measures of cooperation of the countries of the socialist community.

The questions of the planning of work on standardization, including the improvement of the structure of the plans and the increase of the topicality of themes, the bringing of the work as close as possible to the tasks of the implementation of specific measures and agreements on the specialization and cooperation of production, which follow first of all from the priority directions of cooperation, are at the center of attention.

Great importance is being attached to the shortening of the time of the elaboration of CEMA standards by means of the more extensive use as drafts of CEMA standards of the standards of the International Organization for Standardization and the International Electrotechnical Commission and advanced national standards of the CEMA member countries.

A special role is being assigned to the elaboration of CEMA standards, which contribute to the output of products that are of a high technical level and are competitive on the world market.

The CEMA Institute for Standardization is taking a direct part in the planning of the elaboration of CEMA standards. In particular, for the realization of the leading role of standardization with respect to the corresponding measures on cooperation, the assurance of the comprehensive standardization of products, and the creation of a standard technical basis for the fulfillment of measures by the time of the conclusion of agreements on their implementation analyses are regularly made of the multilateral agreements and treaties (or their drafts) on economic, scientific, and technical cooperation. The analyses make it possible to establish the state of the standardization support of the objects of cooperation, which are envisaged in the agreements, and to draw up suggestions on the elaboration of the necessary CEMA standards. The indicated suggestions are sent to the delegations of the CEMA member countries on the CEMA Permanent Commission for Cooperation in Standardization, to sectorial organs, and to international economic organizations of the CEMA member countries for use when preparing drafts of the plans of the elaboration of CEMA standards. An analysis of the programs of work on standardization, which have been adopted by CEMA organs, is also made for the identification of priority themes for the purpose of their subsequent inclusion in the annual plans of the elaboration of CEMA standards.

A significant place in the matter of ensuring a high scientific and technical level of CEMA standards belongs to the appraisal of the drafts of CEMA standards, which is carried out by the CEMA Institute for Standardization in conformity with the Statute on the CEMA Standard and the CEMA procedural materials on standardization.

Here basic attention is devoted to the conformity of the technical norms and requirements, which are established in the drafts of the standards for a specific product, to the norms and requirements of the advanced standards of the countries and international organizations, as well as to the data on the best models of the product.

Along with the preparation of expert conclusions, the norm control and editing of the drafts are performed and their preparation for publication is carried out. Annually the institute prepares more than 1,300 expert conclusions and edits and prepares for publication up to 800 CEMA standards.

The establishment of CEMA standards for products with differentiated levels of the indicators of quality is one of the methods of increasing the scientific and technical level of standard documents. In this connection the institute drew up, while the CEMA Permanent Commission for Cooperation in Standardization adopted procedural instructions which regulate the use subject to the specific conditions of well-defined or differentiated levels of quality, which makes it possible to take into account the level of development of science, technology, and production of the countries which are taking part in socialist economic integration.

The tasks of increasing the level of accuracy of measurements in the CEMA member countries are being accomplished not only by the further development and improvement of the national systems of measurements on the basis of and with allowance made for the achievements of scientific and technical progress, but also by the convergence of these systems for the achievement of the unity of measurements and the mutual recognition of the results of measurements and tests within CEMA.

At present work is being successfully performed on the creation of a set of CEMA standards of weights and measures. For example, today 25 CEMA standards of weights and measures, which in accuracy are at the international level and reflect the latest achievements of modern physics, electrical engineering, precision mechanics, and optics, have been adopted in accordance with the results of analyses and mutual comparisons.

Here it should be noted that in conformity with the program of the development of CEMA standards of weights and measures to 1990 in addition to the existing ones it is planned to elaborate more than 50 more standards of weights and measures in various fields of measurements.

International cooperation in the area of the development of a set of standard specimens of the composition and properties of substances and materials (CEMA standard specimens) is being expanded.

Thus, the List of CEMA Standard Specimens Which Are Necessary for the Purposes of Scientific, Technical, and Economic Cooperation of the CEMA Member Countries for 1981-1990, in conformity with which the development of several hundred types of CEMA standard specimens is planned, has been compiled. More than 300 types of standard specimens have now been recommended for use as CEMA standard specimens.

Moreover, the Agreement on the Development and Use of CEMA Standard Specimens, which specifies the obligations of the countries in this area, has been signed.

Cooperation is also being developed in such a sphere as the search for new forms and methods of the efficient and effective use of materials, raw materials, and energy. Complete and reliable information on the values of the physical constants and properties of substances and materials is necessary for this. In this connection the task has been posed of establishing a standard reference data system on the properties of substances and materials (the CEMA standard reference data system), which will make it possible by the international division of labor and the coordination of research to eliminate the duplication of work on the determination, gathering, evaluation, and storage of the corresponding information, which, in turn, will decrease the expenditures of the CEMA member countries on this activity.

A number of documents of an organizational legal nature, which specify the goals and tasks of the CEMA standard reference data system, as well as the tasks of CEMA organs on its creation, development, and use, the principles of the certification and approval of standard reference data, and the procedure of their transmission and application, were recently drawn up. The experimental use of national collections as thematic collections of the CEMA standard reference data system is being carried out.

The Agreement on Cooperation in the Development and Use of the CEMA Standard Reference Data System, which envisages the organization of work on the gathering and certification of data for the purpose of providing joint measures on economic, scientific, and technical cooperation, as well as the national economy of the countries of the socialist community with reliable data on the physical constants and properties of substances and materials, has been approved.

The Agreement on the Mutual Recognition by the CEMA Member Countries of the Results of State Tests and the Verification of Means of Measurements and the intergovernmental Agreement of the Cooperation of the Time and Frequency Services of the CEMA Member Countries, which envisages the performance of scientific and technical work on this problem, have also been signed.

The basic tasks of cooperation of the countries in the area of the increase of the technical level and quality of products are the forecasting of their quality and technical level; the development and introduction of a coordinated system of certification; the development and harmonization of methods of the evaluation and certification of the technical level and quality of products and systems of their tests and checking; the improvement of the enforceable enactments (documents), which regulate the responsibility for the quality of reciprocally delivered products, the development and improvement of product quality control systems, and so on.

On this basis work has been started on the establishment and implementation of the System of the Evaluation of the Quality and the Certification of Reciprocally Delivered Products on the Basis of CEMA Standards. (The

proposals on the establishment of the system were approved by the CEMA Executive Committee in January 1985.)

Along with the establishment of the indicated system for the purposes of the standardization support of measures, which are aimed at increasing product quality within CEMA, work on the development of uniform principles, methods, and means and the organization of product tests, the preparation of a standard technical base, which ensures product reliability in the process of its designing, production, and use, as well as the development of uniform principles and methods of the evaluation of the technical level and quality of products, which are being reciprocally delivered by the CEMA member countries, are being performed.

Regarding standardization as the scientific and technical basis of designing and the technology and organization of production, the Council for Mutual Economic Assistance is devoting constant attention to its development with the extension and broadening of the economic, scientific, and technical cooperation of the socialist countries.

Thus, the System of Standard Documents on CEMA Activity in the Area of Standardization, Metrology, and Product Quality, the goal of which is the increase of the efficiency and organizational level of the work in this area, the assurance of its close interconnection with measures on the cooperation of the CEMA member countries, and the development on this basis of interconnected advanced CEMA standards, is being developed in accordance with a decision of the 89th meeting of the Executive Committee of the council.

As a whole the system will be a set of standards, which regulate the activity of both the organs and the international economic organizations of the CEMA member countries.

For the purpose of the broader use of standards in the treaty law relations, which are regulated by the Convention on the Use of CEMA Standards, the institute is preparing proposals on the inclusion of references to CEMA standards in treaties (protocols to treaties). Moreover, references will be inserted either in the texts of treaties (protocols on the extension, augmentation, or amendment of prevailing multilateral treaties) or in the appendices to them, since in accordance with practice the technical and economic parameters and characteristics of objects of cooperation are cited precisely in the appendix to a treaty. The proposals on the inclusion of references to CEMA standards are being elaborated in the process of the preparation of drafts of treaties (protocols to them) and during their consideration, coordination, and approval.

At present work is being performed on the inclusion of references to specific standards in the drafts of protocols on the extension for 1986-1990 of the prevailing agreements and treaties and in the drafts of new agreements.

The practice of using CEMA standards in treaty law relations is tending to expand. On 1 October 1985, 1,016 prevailing CEMA standards were used in 72 agreements and treaties and in drafts of agreements and protocols on the extension of prevailing agreements on [word illegible] for 1985-1990.

CEMA standards are also finding greater and greater use in the national economy of the member countries of the convention. Thus, from [figure illegible] to 85 percent of the approved CEMA standards are being used in Bulgaria, Hungary, the GDR, [word illegible], the USSR, and the CSSR, which is contributing to the increase of the efficiency of national standardization and is creating the prerequisites for the development of international specialization and cooperation.

The implementation of the Plan of Cooperation of the CEMA Member Countries in Standardization for 1981-1985 is now being completed. In the past 4 years the CEMA Permanent Commission for Cooperation in Standardization has approved [figure illegible] CEMA standards. In all as of 1 August 1985, 5,125 CEMA standards were in effect. Among this group more than 1,000 standard technical documents regulate the technical level and quality of products. These are standards like technical requirements, general technical requirements, complete performance capabilities (specifications), and general specifications.

More than 1,700 CEMA standards apply to the methods of the monitoring, tests, analysis, measurements, and determinations of product quality, standard specimens of products, the rules of acceptance, and the methods of taking and preparing samples.

Above 1,000 standard documents establish the dimensions and parameters of products, their types, as well as grades and assortment.

Approximately 500 standards are not connected with a specific product; they are CEMA general technical and organizational procedural standards. These are standards, which belong to the CEMA YeSDP, the CEMA Unified System of Design Documentation, and the CEMA Unified System of the Technological Preparation of Production. The standardization of such general technical norms as series of preferable numbers, the tolerances and fits of various connections, the geometric and dimensional parameters of threads, splined and keyed joints, and gear and other transmissions ensures the technical compatibility of items, which are objects of cooperation--the specialization and cooperation of production, joint planning, design, and research work.

More than 400 CEMA standards apply to classification, symbols, methods of calculations, general rules and norms in sectors, terms, and definitions.

The CEMA standards, which ensure the preservation of the properties of a product during its circulation and the information of the consumer about the product, make up a comparatively small group of documents. Among them are standards for the marking, packaging, transportation, and storage of the product.

A relatively small number of standards are in effect in the area of metrological support, including standards for methods and means of testing.

An automated information management system of standardization and metrology within CEMA (AISU SM SEV) is being established for the purpose of increasing

the efficiency of work. The Main Information Center of the AISU SM SEV, within which a computer array of data on the standard technical documents of CEMA, the International Organization for Standardization, and the International Electrotechnical Commission exists and is constantly being updated, has been established at the institute. The preparation of computer indices of the standards of CEMA, the International Organization for Standardization, and the International Electrotechnical Commission (traditional and rotational indices), their output from the computer, and their supply to the delegations of the CEMA member countries on the organs of the council, the CEMA Secretariat, and the organizations, which perform the functions of secretariats of international organizations of the CEMA member countries, are being carried out on the basis of the latter.

Since the utmost increase of the technical level and quality of products is the main task of the economy policy of the CEMA member countries at the present stage, all the activity of the CEMA Institute for Standardization is aimed at the accomplishment of this task.

It is envisaged, in particular, to increase the responsibility of the institute for the completeness of the supply of CEMA standards for the new types of products that are promising for the specialization and cooperation of production, which are being developed by the CEMA member countries, and for the high technical level of the CEMA standards for products on the basis of the comparison of the requirements of the indicators of the CEMA standards with the world level.

The institute has to carry out the organizational procedural support of the establishment, functioning, further development, and improvement of the system of the evaluation of the quality and the certification of products on the basis of CEMA standards.

For the solution of the problem of ensuring the technical compatibility and functional interchangeability of machines, equipment, and instruments the institute proposes to prepare suggestions on the choice of objects of standardization and the organizational methods support of the performance of work within CEMA on standardization.

Measures on the assurance of the broad application of CEMA standards and other standard technical documents in treaty law relations with respect to the cooperation of the CEMA member countries, in particular, the preparation for approval as CEMA standards of international standards and national standards of the CEMA member countries, which are at the world level and are suitable for direct application, as well as the elaboration of suggestions on the application in treaty law relations of the best international and national standards, have been outlined.

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SOVIET-INDIAN GEOGRAPHY SEMINAR PROCEEDINGS DETAILED

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOGRAFICHESKAYA in Russian No 3, May-Jun 86 124-127

[Article by Yu. P. Badenkov, A. Yu. Levitanus, G. A. Privalovskaya, Kh. M. Saidmuradov and G. V. Sdasyuk under the rubric "International Scientific Cooperation": "Scientific Results of the Third Joint Soviet-Indian Geographical Seminar"; passages rendered in all capital letters printed in boldface in source]

[Text] The Third Soviet-Indian Geographical Seminar on the "The Use, Conservation and Management of Natural Resources for Integrated Regional Development" was held 17-27 September 1985 in the USSR (Moscow-Tajik SSR). Participating in the seminar was the Soviet delegation (head--Yu. P. Badenkov, candidate of geological and mineralogical sciences; deputy director, Geography Institute of the USSR Academy of Sciences; chairman, Organization Committee--Kh. M. Saidmuradov, corresponding member, Tajik SSR Academy of Sciences) and the six-person Indian delegation headed by Professor Manzur Alam, vice-chancellor of Kashmir University.

The task of Soviet-Indian seminars is to exchange the experience of scientists of the two countries in various fields of science, including geography. The seminar is one of the links in the fruitful cooperation of Soviet and Indian geographers, which has been successfully developing since the beginning of the 1960's (the Geography Institute of the USSR Academy of Sciences is the permanent Soviet head organization). This cooperation has gone through several stages, starting with the mutual publication of articles, followed by the publication of joint books that were presented at the various international geographical congresses (Economic Zoning of India: Problems and Approaches, New Delhi, 1968; Economic and Sociocultural Aspects of Zoning, New Delhi, 1972; Urbanization in the Developing Countries, Hyderabad, 1976). They received high marks from the international scientific community.

Soviet-Indian geographical seminars have been conducted since the end of the 1970's ("Regional Development and State Planning," USSR, 1978; "Rational Use and Conservation of Renewable Natural Resources and Regional Development," India, 1980). They are noted among the best in a vast series of Soviet-Indian seminars on various socioeconomic, political and other topics that are

conducted in accordance with the agenda of the Soviet-Indian Commission on Cooperation in the Social Sciences.

The program of the Third Soviet-Indian Geographical Seminar was organizedin accordance with the aim of examining problems pertaining to the utilization, conservation and management of natural resources for integrated regional development. The specific experience of Tajikistan is the "key" to the study of analogous problems in the context of the entire Central Asian region and the latter is regarded as one of the macroregions in the unified national economic complex of the USSR.

The work of the seminar included theory sessions at which 6 reports by Indian and 27 reports by Soviet scientists and field trips (that included field scientific sessions) to regions of Leninabad and Kayrak-kum Reservoir, Dushanbe, Kurgan-Tyube and the Vaksh Valley, the Nurek Hydroelectric Power Plant and the Varzob Gorge were presented and discussed.

Field excursions had more than purely cognitive significance in both essence and spirit. They furnished graphic proof of the successful application of scientific research in the activity of kolkhozes, sovkhozes, state agricultural experimental stations, industrial enterprises, etc. These excursions made it possible to get an idea of the high level of theoretical and applied research in Tajikistan's scientific centers. The experience of the development of science and the socioeconomic attainment of the Central Asian region of the USSR hold considerable interest for India. The strategy developed by Soviet scientists for managing Central Asia's water resources holds special significance for India. Equally valuable to India is the Soviet experience in combating desertification.

The reports by Indian scientists shed light on a wide range of problems pertaining to the more rational use of water resources. This is of great interest both with respect to the methodology and methods used in their study and to practical recommendations. The problem of optimizing the use of water resources is critical in many regions of India and the USSR. Therefore the exchange of knowhow in this area was especially important and useful to both sides.

The work of the seminar was concentrated on the discussion of problems pertaining to: (1) the methodology of the study of natural resources and their role in integrated regional development; (2) the rational use and management of natural resources (with emphasis on water resources); (3) integrated regional development based on the example of the Central Asian macroregion of the USSR; (4) the rational use, conservation and management of resources and the integrated socioeconomic development of the Tajik SSR.

TAJIKISTAN'S REGIONAL DEVELOPMENT EXPERIENCE. Introduction to the specific experience of the Tajik SSR occupied a central place in the work of the seminar. The problem of evaluating and making rational use of natural and labor resources of Tajikistan and ways of resolving problems pertaining to the integrated socioeconomic development and conservation of the environment were discussed on the basis of a series of reports presented by economists, geographers, biologists and mathematicians of the Tajik SSR Academy of

Sciences (Tajik SSR Academy of Sciences academician Z. D. Usmanov; corresponding members of the TaSSR Academy of Sciences: Kh. M. Saidmuradov, S. G. Negmatullayev, M. R. Rasulova, B. S. Sanginov, and others).

Tajikistan is the republic with the highest rate of natural increase in population, especially rural population, in our country. Consequently, the intensification of natural resource utilization under the conditions of high population density acquires great importance. The discussion centered on different variants of socio-demographic, ecological and economic development. The "active variant," which essentially entails the application of such forms and methods of regional resource utilization that would correspond to the growth of the final social and economic effect while simultaneously improving the state of the environment, appears to be the most rational. The further enhancement of the role of Tajikistan's agriculture in the all-union division of labor, the universal transition to the use of progressive irrigation techniques, the dramatic expansion of the sphere of application of biological methods of controlling agricultural pests, and the systematic and scientifically substantiated resolution of the problem of organizing production and settlement in mountain regions were noted among the specific measures in this area.

As Indian scientists emphasized, owing to the similarity of natural conditions with countries in subtropical zones and the unique (under the conditions of the USSR) demographic situation, which is in many respects similar to the Indian situation, study of the experience of the socioeconomic development of Tajikistan is of special interest.

THE CENTRAL ASIAN MACROREGION OF THE USSR. A broad spectrum of scientific reports of leading specialists of all Central Asian republics on rational natural resource utilization and integrated regional development was presented at the seminar.

The concluding round table sitting of the seminar in Dushanbe and special reports, especially the report by G. V. Kopanev, doctor of economic sciences; chief, Central Asian sector of SOPS [Council for the Study of the Productive Forces] of USSR Gosplan, characterized and discussed the problem of ecological, resource and socioeconomic development of the Central Asian economic macroregion.

Central Asia disposes over a complex, ramified water complex that for many years has almost completely regulated all river runoff. Nevertheless, the increasing strain on the water balance is becoming an increasingly important factor. This is due not only to the limited nature of water runoff but also to the development of new land, the siting of large new production complexes and urban development. In other words, the development of the economy intensified the strain on water resources required for its further development, which in turn required improvement in the cotton complex in order to improve its adaptation to the increasingly complex water supply conditions.

PROBLEMS AND WAYS OF OPTIMIZING THE UTILIZATION OF WATER RESOURCES: THE EXPERIENCE OF INDIA AND THE USSR. Water resources are among the limiting factors of economic development of many regions of the USSR and India.

Research on transformations of water resources becomes increasingly important in this context. A new scientific direction--the anthropogenic direction, the task of which is to evaluate and predict the influence of various types of human activity on river runoff and other types of water resources--is emerging in hydrology. As emphasized in reports by candidates of geographical sciences N. I. Koronkevich and G. M. Nikolayeva, I. D. Tsigelnaya (Geographical Institute of the USSR Academy of Sciences), and A. B. Avakyan, doctor of geographical sciences (Institute of Water Problems, USSR Academy of Sciences), the scale of anthropogenic influences on water resources is to an ever greater degree limited to the need to conserve the environment and its individual elements. This applies to the maximum degree to the protection of water against pollution, to the reduction of the area of flooding in the construction of hydroengineering facilities, and the degradation and salination of topsoil during irrigation. To a significant degree, the corresponding nature conservation measures are already being implemented.

An important place in the seminar was taken up with the discussion of the problem of making more effective use of water in irrigation farming, which was the subject of reports by V. A. Dukhovnyy, doctor of agricultural sciences; director, Central Asian Scientific Research Institute of Irrigation, USSR Ministry of Land Reclamation and Water Resources; and S. K. Ziyadullayev, UzSSR Academy of Sciences academician; chairman, UzSSR SOPS. Reports by Indian scientists on the development of the water-saving technology of irrigation were of great practical interest.

India's experience shows that in the absence of specific, quantitatively determined recommendations, peasants tend to overirrigate. This leads to the unproductive expenditure of water and to the higher expenditure of electricity and diesel fuel in the operation of pumps in addition to causing serious harm to the quality of the soil. After many years of experiments, scientists developed optimal irrigation schedules for various crops that made it possible to achieve high yields while economizing irrigation water from 20 to 60 percent and reducing damage to the soil to a minimum.

Such a substantial saving of irrigation water (which can be used to irrigate other crops) means lower irrigation costs. In India, it is important that irrigation schedules are used free of charge and that they can be easily understood by peasants. Thus, the development of irrigation schedules as part of the water resources management process is a highly promising area of scientific research.

The report by Indian scientist H. S. Mavi contained a number of formulas for determining evaporation and filtration losses that can be useful but that need to be tested. Reports by other Indian scientists confirm the fact that India has a large body of material on this question. In order to reduce losses of water due to seepage, it is recommended that both main and feeder canals be revetted. It is similarly recommended that underground pipes be used to avoid losses of water in regions that irrigate with well water.

Even if irrigation farming is developed to the fullest, a considerable percentage of the crops in both the USSR and India will be produced by unirrigated (boghara) farming. At the same time, it is possible to employ

inexpensive agrotechnical and forest and land improvement measures that substantially raise the productivity of this kind of agriculture. The report by G. S. Gosal contained a number of similar recommendations that can also be useful in arid regions of the USSR. They include the use of straw mulch on crops as well as strip farming in which water for the sown strip is collected from neighboring profiled slopes. This improves the water supply of farm crops in areas with a general lack of moisture. The task of preserving moisture in the soil can be achieved by contouring the fields, by collecting moisture in the furrows and by other methods.

A considerable place in the work of the seminar was taken up with the discussion of principles and methods for optimizing the distribution of water resources between consumers--administrative-territorial units and branches of the economy and in India--individual private farms as well. In this regard, Indian scientists (S. Brahme and F. Alikhan) found much interest in the USSR's experience in distributing water resources between individual republics, including the legal basis of plans for redistributing runoff.

As M. Alam noted in his report, the pollution of water sources can become a serious problem for India in the near future. The nation is still not devoting sufficient attention to the prevention of river pollution because this is still considered a local problem. The report called for abandoning this dangerous illusion and recommended the inclusion of nature conservation measures in all national and regional development plans.

Participants in the seminar noted that water resources management in all its complexity is the key to the development and stabilization of agricultural production in regions of irrigation as well as boghara farming and in farming under arid, semiarid and subhumid conditions.

Methods for measuring and evaluating water resources (of both surface and ground water must be improved in order to ascertain the precise balance between available resources and the need for them. India can benefit greatly from the scientific research conducted in this area in the USSR. This is obviously a promising area for joint work by scientists of both countries.

THE METHODOLOGY OF STUDYING NATURAL RESOURCES AND CERTAIN GLOBAL AND REGIONAL PROBLEMS OF RESOURCE CONSUMPTION. The problem of developing specific "key" territories and of the integrated development of macroregions was examined at the seminar against the background of global-regional problems of interaction between society and nature. The report by E. B. Alayev, doctor of economic sciences, (SOPS) defined the very concept "resources" as a necessary condition to economic development. The USSR has amassed a wealth of experience in the organization of rational resource utilization and has developed its basic principles.

Rational resource consumption requires an integrated approach at the all-union, regional and local levels. As G. A. Privalovskaya, doctor of geographical sciences (Geographical Department, USSR Academy of Sciences), noted, this necessitates the development of integrated resource charts in addition to branch charts. The reciprocal coordination of all-union branch and regional integrated charts of rational natural resource utilization and

their reciprocal coordination with various pre-plan and plan elaborations are possible on the basis (1) of an all-union concept of rational natural resource utilization and (2) a specially devised national zoning chart. The study of constructive activity relating to the rational use of natural resources in the USSR has application to such urgent global problems of modern time as the struggle against desertification and the strategy of integrated development of mountain regions.

The report by G. V. Sdasyuk, doctor of geographical sciences (Geographical Institute, USSR Academy of Sciences) noted that quantitatively and qualitatively adverse trends of anthropogenic origin are seen in all natural systems. One of the most menacing processes of modern time--the unprecedented destruction of the planet's living matter--is anthropogenic abiotization. The center of gravity of global ecological problems is increasingly shifting to the developing countries that are located in subtropical and tropical zones and that have far less potential than the developed countries to block these destructive trends.

The interconnection between mass deforestation, erosion, the declining natural productivity of the soil, the expansion of desertification processes, the increase in the intensity of natural calamities--drought, floods, etc.--is obvious. The expansion of desertification (devastation)--of the decline and in extreme cases the destruction of the earth's biological potential--is one of the most destructive anthropogenic processes of modern time.

The report by A. G. Babayev, corresponding member, USSR Academy of Sciences; president, TuSSR Academy of Sciences, was devoted to this topic.

As the Indian scientists noted, it follows from the reports by Soviet specialists that major advances have been made in the investigation of desertification processes and problems. Even though this is a global problem that requires the joint efforts of all interested countries, there is a serious basis for joint research on these problems by Indian and Soviet scientists. The Soviet experience will be important for the Institute for Research on the Arid Zone in Jodhpur (India), which has concentrated its efforts on scientific research in this direction, as well as for other agricultural scientific institutions and will help in the formulation of the appropriate strategies.

Mountainous regions with diverse resources in many parts of the world have not been sufficiently studied for the purpose of accelerating socioeconomic development and raising the population's standard of living. As a result, some of them have remained backward. In India, which abounds in mountainous regions, little attention has been devoted to these regions up to now.

The USSR has amassed a wealth of experience in multilateral and bilateral cooperation on problems of mountainous regions, in particular, within the framework of UNEP and UNESCO-MAB projects and, cooperation with CEMA countries. The report by Yu. P. Badenkov, candidate of geological and mineralogical sciences (Geographical Institute of the USSR Academy of Sciences) showed broad possibilities and great perspectives of Soviet-Indian

cooperation in the study of ecological and economic problems of mountainous regions.

Summing up the results of the Third Soviet-Indian Geography Seminar, its participants deem it appropriate:

1. To publish the scientific results of the seminar in Russian in the USSR and in English in India by March 1987 so that these publications would be available for the Fourth Soviet-Indian Geography Seminar to be held at Kashmir University (Srinagar).

2. To include in the plans for Soviet-Indian scientific cooperation the holding of the Fourth Geography Seminar in India in March 1987 on the topic "Ecological and Geographical Evaluation of the Present Stage and Strategy of Integrated Development of Mountainous Regions (the Indian and Soviet experience), with special attention to the study of the following problems:

2.1. Stability and variability of mountain ecosystems: anthropogenic transformation of mountain regions and analysis of conflict situations;

2.2. Resource-ecology potential of mountain regions; resources and constraints; demographic, ethnic and socioeconomic factors and systems of settlement;

2.3. Organization of interdisciplinary scientific research in mountain regions: concepts and methods;

2.4. Strategy of the balanced (integrated) development of mountainous regions, submontane regions and plains;

2.5. Integrated monitoring of mountainous regions (socioeconomic and ecological-geographical aspects).

The study of ecological and economic problems in the development of mountainous regions (such as the Himalayas), one of the acute global problems of modern times is included in the number of international problems in particular for the Hindu Kush-Himalaya region (UNEP, UNESCO-MAB, UN University, ISIMOD, and others). The unification of the efforts of Soviet and Indian scientists in this area would have great international significance.

Soviet-Indian scientific cooperation that has been developing for more than a quarter century in the field of geography shows how fruitful and mutually beneficial it can be despite all the differences in socioeconomic systems and other conditions. The further development and inclusion of new constructive forms of cooperation (the organization of permanent stations, the performance of joint field work, etc.) by Soviet and Indian geographers can be useful not only for the scientific and economic progress of our two great nations but also for the entire world in general.

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PROBLEMS OF INTENSIFYING SCIENTIFIC, TECHNICAL ACTIVITY

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 8, Aug 86 pp 120-121

[Article by Candidate of Economic Sciences A. Solovyev under the rubric "Scientific Life": "Problems of the Intensification of Scientific and Technical Activity"]

[Text] In May 1986 the USSR State Committee for Science and Technology held the All-Union Applied Science Conference "Economic Organizational and Social Problems of the Intensification of Scientific and Technical Activity." Leading specialists in the science of science from academic scientific research institutes and higher educational institutions of the country, managers of sectorial scientific institutions and enterprises, staff members of ministries and departments, and others took part in it.

Deputy Chairman of the USSR State Committee for Science and Technology A.M. Kutepov opened the conference. He directed the attention of the conference participants to the need for the quickest creation of the conditions of an organizational management and economic nature for the efficient functioning and the large-scale use of the results of academic, sectorial, and VUZ science. For the present only a third of the registered discoveries are being used in production, only 15 percent of the inventions and discoveries are being introduced at more than two enterprises, half of the domestic types of new equipment, which have been patented abroad, are being assimilated by our industry. In other words, the demands on the improvement of the mechanism of the management of the scientific potential stem from the need both for the increase of the volumes of the use of scientific and technical achievements and for the improvement of the results of the activity of science itself.

For the purposes of increasing the efficiency of the scientific and technical level of scientific research institutes and design bureaus and increasing their influence on the technical level of the production of output and labor productivity it is necessary to concentrate resources on the most important directions of scientific and technical progress--the development of electronics, integrated automation, the processing of new materials, and so on. Scientific research institutes and design bureaus should make a significant contribution to the fulfillment of the Food and Energy Programs and the programs of the chemicalization of the national economy, consumer goods production, and the sphere of services. The ultimate goal of scientific

and technical activity is the provision of two-thirds of the increase of the productivity of national labor by means of the use of the achievements of science and technology.

Those who spoke at the plenary sessions noted that the prevailing mechanism of the management of science for the most part was formed during the period of the extensive development of the economy. To a significant degree it was borrowed from production, although scientific activity is specific. Therefore, new independent economic organizational levers of its management are necessary.

Doctor of Economic Sciences V.G. Lebedev (the Academy of Social Sciences attached to the CPSU Central Committee) dwelled on the peculiarities of the present stage of the scientific and technical revolution and the tasks of the intensification of scientific and technical activity: to speed up the formation of the network of scientific production complexes, which ensure the introduction and use of the basic achievements of science; to make an inventory of all the production engineering systems in conformity with the world technical level; to introduce the certification of the management staff of science; to supplement the existing statute on economic stimulation funds in science with allowance made for the initial expenditures and the lag of the return.

Candidate of Economic Sciences V.P. Groshev (the Academy of Social Sciences attached to the CPSU Central Committee) emphasized that the integration of scientific, technical, and production activity should contribute to the transition of the economy to a qualitatively new state.

For the purpose of surmounting the departmental isolation in research and development it is necessary to improve the interaction of the academic, sectorial, and VUZ sectors of science and research in the area of the social, technical, and natural sciences.

Honored Figure of Science of the RSFSR Doctor of Economic Sciences A.N. Lyusov (the Academy of the National Economy attached to the USSR Council of Ministers) analyzed the questions of the improvement of the planning of the activity of scientific institutions. The singling out of a small number of long-term all-union scientific and technical programs is the basis of the formulation of plan assignments. The thematic order of ministries and departments for the performance of the most important scientific research may become the main planning document for scientific research institutes and design bureaus. The research and development, which are conducted in accordance with coordinating plans, should be financed by the main organizations. It is advisable to use cost accounting relations by means of the conclusion of a supply order between the scientific institution and its structural subdivisions. It is important that the amount of economic contractual work being performed would be determined by the scientific institution itself, and not by the superior organization. Here only 60 percent of the established common wage fund (and accordingly the bonus portion) should be provided at the expense of the state budget, while the remainder should be covered from economic contractual sources.

Doctor of Economic Sciences A.K. Kazantsev (the Leningrad Institute of Engineering Economics imeni P. Togliatti) covered the questions of the comprehensive analysis of scientific and technical activity in the sectors of industry: the identification of internal reserves, the monitoring of the level and orientation of research, the increase of its economic efficiency. However, in the opinion of the speaker, analytical work is being checked by the lack of standard procedural documents which regulate the set of indicators of analysis in various sectors. It is necessary to formulate standard procedural instructions on the making of a comprehensive analysis of the scientific and technical activity of scientific research institutes and design bureaus at all levels of the management of science.

Doctor of Economic Sciences O.I. Volkov (the Moscow Institute of the National Economy imeni G.V. Plekhanov) examined the problems of the intensification of the activity of the scientific institutions of VUZ science. He noted that it is advisable to broaden the sphere of use of the scientific and technical potential of higher educational institutions by means of comprehensive problem research and to limit the share of economic contractual work in accordance with orders of sectors to 30-40 percent, moreover, only for the accomplishment of important tasks of an interdisciplinary nature. The use of students in the performance of research and development is a large reserve of VUZ science.

Candidate of Economic Sciences A.I. Kazakov (the USSR State Committee for Science and Technology) gave information on the work on the improvement of the forms of the integration of science with production, the methods of solving the economic problems of the functioning of scientific production associations, the means of developing economic experiments in a number of sectors of the country, and the experience of the temporary scientific and technical laboratories at the USSR Academy of Sciences. The drawing up of procedural documents on the planning, stimulation, and material and technical supply of the activity of scientific institutions, interbranch scientific technical complexes, scientific production associations, and others is playing an important role in the improvement of the economic mechanism of science.

Doctor of Economic Sciences Yu.V. Yakovets (the Academy of the National Economy attached to the USSR Council of Ministers) noted the priority importance of advanced innovations for the cardinal acceleration of scientific and technical progress. It is necessary to make the transition to the comprehensive planning of developments and the assimilation and dissemination of new generations of equipment, providing them in a priority manner with resources. It is important to back the plan assignments on the assimilation of new types of equipment with financial, economic, and credit levers, reimbursing at the expense of the assets of scientific and technical progress the costs of assimilation and extending the differentiation of prices for equipment subject to its novelty. It is necessary to evaluate the economic efficiency of scientific and technical activity on the basis of the full national economic impact.

In the discussion, which developed at the sectional sessions, scientists and specialists emphasized that an effective mechanism of the increase of the efficiency of the scientific and technical activity of scientific research institutes and design bureaus should be formed not by the accomplishment of

specific tasks, but by the changeover of science to intensive development with the orientation of each link in the "science-technology-production" chain toward the achievement of high end national economic results.

The need for the acceleration of the development of a mechanism of the increase of the efficiency of science and the improvement of the methods of its management as an independent sphere of national economic activity was noted in the decision which was adopted at the conference. The most important tasks are: the coordination of all research on questions of the management of science, the regular holding of intersectorial conferences on the science of science, the establishment of a press organ for questions of the management of science, and a scientific council of the USSR State Committee for Science and Technology for problems of the efficient use of the scientific and technical potential.

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BIOGRAPHICAL INFORMATION

GEORGIAN EARTHQUAKE-PROOF CONSTRUCTION EXPERT HONORED

Tbilisi ZARYA VOSTOKA in Russian 2 Oct 86 p 3

[Article: "Recognition of a Scientist's Services"]

> [Text] E. A. Sekhniashvili, academician, republic [Georgian SSR] Academy of Sciences, has been elected to membership in the Scientific Council of UNESCO's International Network of Earthquakeproof Construction Centers]

E. Sekhniashvili is the originator of the theory of earthquakeproofness of prestressed reinforced concrete components. He is the author of roughly 100 scientific works, including two monographs on structural mechanics and the theory and testing of structures for earthquakeproofness.

A number of the scientist's works are devoted to methodology and substantiation of the integrated utilization of lightweight concrete and reinforced concrete in regions of the nation that are subject to earthquakes. Owing to this work, USSR Gosstroy [USSR State Committee for Construction Affairs] has authorized the design and construction of totally prefabricated multistory residential buildings from the most effective construction material--lightweight concrete--in the nation's seismically active regions.

The election of the Georgian scientist to a position of leadership in the representative international organization took place at a conference of earthquakeproof construction specialists in Udine, Italy. The Soviet Union was also represented by another famous Georgian scientist: Dzh. Lominadze, corresponding member, Georgian SSR Academy of Sciences; acting academician-secretary, Mathematics and Physics Department, republic [Georgian SSR] Academy of Sciences.

At the conference, E. Sekhniashvili proposed the organization of an international center for earthquakeproof construction in Georgia under the aegis of UNESCO. In support of his proposal, which was acclaimed by a number of prominent British, Italian and Yugoslav scientists, he referred to the high level of Soviet, and especially, Georgian research in earthquakeproof construction and allied sciences. Thus it was specifically in Georgia that K. S. Zevriyev, academician of the Georgian Academy of Sciences, formulated for

the first time the dynamic theory of earthquakeproofness which is now being successfully developed throughout the world. There is practically not a single Georgian scientific research construction institute that does not address the problem of earthquakeproofness of structures. In addition, the zonal Scientific Research Institute of Standard and Experimental Design of Residential and Public Buildings, the Georgian Scientific Research of Energy and Hydraulic Engineering Structures and the "GruzNIIstrom" integrated scientific research institute of construction materials are operating successfully in Tbilisi.

Considerable research on earthquakeproof construction and the forerunners of earthquakes is carried out at the Institute of Structural Mechanics and Earthquakeproofness, Georgian SSR Academy of Sciences im. K. S. Zavriyev; at the institutes of geophysics, computer mathematics imeni N. I. Muskhelishvili and mathematics imeni A. M. Razmadze of the Georgian SSR Academy of Sciences; at the Institute of Applied Mathematics of Tbilisi State University imeni I. N. Vekua; and at the Georgian Polytechnical Institute imeni V. I. Lenin.

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BIOGRAPHICAL INFORMATION

UZBEK ACADEMICIAN USMANOV HONORED ON 70TH BIRTHDAY

Tashkent PRAVDA VOSTOKA in Russian 16 Oct 86 p 3

[Article by Professor Yu. Tashpulatov, doctor of chemical sciences; corresponding member, Uzbek SSR Academy of Sciences; director, NIIKhTTs [Scientific Research Institute of Cotton Cellulose Chemistry and Technology]; "Scientist and Soldier. On the 70th Birthday of Kh. U. Usmanov, Academician of the UzSSR Academy of Sciences"]

[Text] Khamdam Usmanovich Usmanov, academician, UzSSR Academy of Sciences, belongs to the galaxy of Uzbek intellectuals who had the good fortune to be schooled in science by leading Russian scientists who arrived in Tashkent in 1920 with the first Leninist "science train." Khamdam Usmanovich recalls the names of the professors of that glorious cohort--Muraveyskiy, Kolosovskiy, Naumov--with a deep feeling of gratitude.

Kh. U. Usmanov graduated cum laude from the chemical faculty of the Central Asian State University at the age of 21 years in 1937 and remained in the physical chemistry department. In 1941, now a candidate of chemical sciences, he went to the front and participated in battles for the liberation of Romania, Hungary, Austria and Czechoslovakia. For courage and bravery, he was awarded two Orders of the Red Star and six medals, inter alia, for the taking of Budapest and Vienna. He became a member of the CPSU in the grim year of 1943, having been recommended for party membership by old bolsheviks who were members of the CPSU from 1916 and 1919, before his departure for the front.

Following the war, Kh. U. Usmanov pioneered republic research in a new field of science--polymer chemistry--initially at the university and later in the Academy of Sciences. Khamdam Usmanovich attracted young people to promising new fields of research and organized Uzbekistan's first laboratory for the chemistry of natural polymers. This laboratory became the Institute of Polymer Chemistry, UzSSR Academy of Sciences, which in 1964 became NIIkhTTs [Scientific Research Institute of Cotton Cellulose Chemistry and Technology].

Kh. U. Usmanov is renowned as a major science organizer. He was the director of the Institute of Chemistry (1951-1956); [Institute of] the Chemistry of Vegetable Raw Materials and Cotton (1956-1959) and [Institute of] Polymer Chemistry of the UzSSR Academy of Sciences (1959-1963). He served as academician-secretary of the Chemical and Technological Sciences Department of

the UzSSR Academy of Sciences and was the first director of NIIKhTTs (1964-1982).

Kh. U. Usmanov was the initiator of many promising directions in the chemistry and technology of polymers developing in the republic and organized a numbmer of departments and problem laboratories in VUZ's. A brilliant facet of his activity was his unceasing concern for the training of chemists. He trained 11 doctors and over 120 candidates of sciences. The academician and his numerous pupils laid the foundations of scientific concepts of the structure of cotton cellulose in the process of its biosynthesis.

Of great theoretical and practical significance are his research on the kinetics of the structure formation of cotton cellulose with the use of marked atoms in the process of its maturation; his work on the development of integrated methods for investigating structural features of cotton, viscose and acetate fibers and their modification for the purpose of creating materials with given properties. Special emphasis is merited by electron microscope methods developed by Kh. U. Usmanov together with G. V. Nikonovich and K. Kh. Razikov for the study of cotton fiber, that resulted in a working hypothesis of the structure of cellulose.

Kh. U. Usmanov and his colleagues Yu. T.Tashpulatov, U. Tishabayev and Sh. U. Saidova developed a number of technological processes for producing cotton cellulose from lint and other cotton waste for the production of plastics used in the production of eyeglass frames and filtering materials used in the production of chemical fibers and additives for oils and lubricating compounds used in home air conditioners, which have been successfully introduced in our national economy. Research under the supervision of Academician Usmanov on the integrated utilization of cotton stalks resulted in the development of economical technology for producing wood-fiber blocks, cardboard and paper and inexpensive raw materials for the hydrolysis industry.

Kh. U. Usmanov is a major populizer of scientific knowledge. He is the chief editor of the editorial collegium of the UzSSR Academy of Sciences for the publication of popular scientific brochures and of Gosplan UzNIINTI's journal YANGI TEKHNIKA. He initiated publication of a series of brochures "From Scientists to School Pupils" and others.

The services of Kh. U. Usmanov in the development of polymer chemistry have been recognized by the scientific community in our country and abroad. He is an honorary member of the polymer section of the American Chemical Society and a member of the editorial collegium of the international journal of cellulose physics, chemistry and technology published by the Romanian Academy of Sciences. For services in the development of science and technology and in training young scientists, Academician Usmanov has been awarded two Orders of Labor Red Banner and the Order of the Badge of Honor. He has been named Distinguished UzSSR Scientist and Technologist. He is winner of the UzSSR State Prize imeni A. R. Beruni. Today, at the age of 70, he is still a scientist engaged in a tireless quest.

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